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Indian Standard

IS 16231 (Part 3) : 2019

भवनों में काँच के प्रयोग — रीति संहिता

भाग 3 आग और बल

(पहला पुनरीक्षण)

Use of Glass in Buildings — Code of Practice

Part 3 Fire and Loading

(First Revision)

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FOREWORD

This Indian Standard (Part 3) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

Glazing is an important item in building construction, and glass, the primary glazing element has to be selected to cater to several requirements. Fixing of glass is a specialized operation, when properly done, shall avoid the hazards of broken glass. Growing trend in resorting to glazed windows/doors in buildings and structures has considerably increased the importance of glazing and the need for proper workmanship. This standard was, therefore formulated to provide required guidance and provisions on the subject matter.

This Indian Standard is published in four parts. The other parts in this series are:

Part 1	General methodology for selection
Part 2	Energy and light
Part 4	Safety related to human impact

This standard (Part 3) was first published in 2016 to determine the appropriate thickness of glass used in building construction.

Correct selection of materials to be used in glazing for buildings depends on many factors. Therefore, provisions in this standard should be used in conjunction with those in other parts.

Use of organic coated films including safety films on glass (say annealed) shall not classify the glass as safety glass as per this standard, and hence users should exercise caution in choosing their options. This revision of the standard is aimed at bringing the provisions at par with the provisions of the SP 7 (Part 6/Sec 8) : 2016 'National Building Code of India 2016: Part 6 Structural Design, Section 8 Glass and Glazing'.

In this revision, the following major changes have been made:

a) The fire safety provisions related to use of glass have been comprehensively reviewed related to the following, to be in line with SP 7 (Part 4) : 2016 'National Building Code of India 2016: Part 4 Fire and Life Safety':
   1) Fire rating criteria,
   2) Application of glass in buildings,
   3) Fire resistance rating of elements, and
   4) Installation of fire resistant glazing system.
b) The calculations for wind load and seismic forces have been revised to be based on the latest version of relevant Indian standards.
c) Caution with respect to delamination while using sealants in laminated glass has been introduced.
d) Minimum width of glazing bite has been included for glazing systems.
e) Definitions of various terms have been updated as per the prevailing engineering practice.

An informative annex on installation of mirrors is given at Annex E.

The composition of the Committee responsible for the formulation of this standard is given in Annex F.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

USE OF GLASS IN BUILDINGS — CODE OF PRACTICE

PART 3 FIRE AND LOADING

(First Revision)

1 SCOPE

1.1 This standard (Part 3) covers the selection of glass in buildings subject to wind loading, seismic loading and special considerations for fire rated glass including its related materials.

1.2 This standard does not cover the following:

a) Glazing system including frameless glazing system, and

b) Patent glazing.

NOTE — The provisions of this standard pertain to selection of glass and associated materials. However, parties, as per their mutual agreement, may appropriately utilize the relevant provisions for installation of alternative sheeting materials used for similar purposes such as plastic glazing sheets/polycarbonate sheets taking also into account requirements of safety issues as applicable with the specific material.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subjected to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 APPLICATION

While selecting the glass for application, the thickness and type of glass required shall satisfy the following criteria:

a) Thickness of glazing is calculated subjected to wind load as per the provisions of this standard;

b) Selection of glass from their different types, requirements and associated glazing materials, IS 16231 (Part 1) shall be referred;

c) For criteria on optical, solar and thermal performance, IS 16231 (Part 2) shall be referred; and

d) For criteria on safety with respect to human impact, IS 16231 (Part 4) shall be referred.

4 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 14900, IS 2553 (Part 1) and the following shall apply.

4.1 Annealed Glass (*see* **4.30**) — Also known as 'normal' glass, which has not been subjected to toughening, lamination and heat strengthening. It is the product obtained from the process of slow and steady cooling of hot glass in order to relieve internal stresses or thermal induced stresses.

4.2 Annealed Fire Resistant Glass — Type of glass which is made out of annealed glass combination and is tested for the required duration and satisfies the intended criteria of fire resistance. These types of glasses may not possess the best of the impact resistance characteristics and may be used as vision panels.

4.3 Aspect Ratio — The ratio of a longer side of glass pane to its shorter side.

4.4 Balustrade — A low barrier forming a parapet to a stair, ramp, balcony, raised level or a change in level.

4.5 Beads or Glazing Beads — A strip of wood, metal, unplasticized polyvinyl chloride (uPVC), aluminium, metal alloys or other suitable material attached to the rebate to retain the glass in position in the frame.

4.6 Bite — The minimum distance by which the inner edge of a frame (or a stop) overlaps the edge of the glass panel.

4.6.1 *Glazing Bite* — The dimension by which the framing system overlaps the edge of the glazing infill.

4.7 Block (Setting Block) — A small piece of wood, plastic, rubber or other suitable material used between the edges of the glass (generally the bottom edge only) to centralize the glass in the frame (frequently called a setting block).

4.8 Clear Glass — A transparent glass with neutral/near colourless appearance.

4.9 Combustible Material — The material which when burnt adds heat to a fire when tested for combustibility in accordance with IS/ISO 834-1.

4.10 Curtain Wall — Non-load bearing structure/partition of glass attached to the building frame, usually on the exterior face. Curtain wall vertical framing members run past the face of floor slabs, and provision for anchorage is typically made at vertical framing members only.

NOTE — In contrast to combination assemblies and composite units, curtain wall systems often need to meet additional performance requirements for inter-story differential movement, seismic drift, dynamic water infiltration, etc. Operating vents and entrance doors are provided as separate inserts.

4.11 Distance Piece — A small piece of wood or other suitable material used to locate the glass between the bead and the back of the rebate to prevent lateral movement.

4.12 Door or Shutter Assembly Door-set — A pedestrian door-set or industrial type door-set including any frame or guide, door leaf or leaves, rolling or folding curtain, etc, which is provided to give a fire resisting capability when used for the closing of permanent openings in fire resisting separating elements, which includes any side panel(s), vision panel(s), flush over panel(s) and/or transom panel(s) together with the building hardware and any seals (whether provided for the purpose of fire resistance or smoke control or for other purposes such as draught or acoustics) which form the assembly.

4.13 Double Glazed Fire Resistant Glass — A fire resistant glass that is used in a double glazed unit.

NOTE — These shall be tested as a complete Double Glazed Unit (DGU) or other multiple glazed units as the case may be. Double glazed fire resistant glass can be a combination of intumescent laminated fire rated or tempered fire resistant glass. Fire resistant glass cannot be combined with another glass and used as a DGU unless the combined double glazed or multiple glazed units are also tested.

4.14 Double Glazing — Glazing formed by an assembly of two glass panes separated by a spacer and the gap may be filled by air or inert gases and hermetically sealed along the periphery to improve thermal insulation.

4.15 Edge Faults — The faults that affect the as-cut edge of the glass. They may include entrant/emergent faults, shelling, corners on/off and vents.

4.16 Edge Polished — It is usually applied to flat glass, the edges of which have been polished after cutting.

4.17 Edging — Grinding the edge of flat glass, to a desired shape or size.

4.18 Exposed Edge — A glass pane’s edge that is not covered.

4.19 Faceted Glazing — It is a type of glazing in which flat panes of glass are installed vertically at an angle to each other to form a faceted surface.

NOTE — While no frames are used normally, in special cases, frames may also be used to achieve/maintain the curve.

4.20 Fire Resistant Glass — Fire resistant glass is a specially engineered glass to withstand extreme levels of heat, restrict heat transfer and prevent passage of smoke and flame.

4.21 Fire Resistance — Fire resistance is a property of an element of building construction and is the measure of its ability to satisfy for a stated period, some or all of the following criteria:

a) *Load bearing capacity* (*Stability*) (*R*) — The ability of a load bearing element to withstand fire exposure without any loss of structural stability.
b) *Integrity* (*E*) — resistance to penetration of flame and hot gases.
c) *Insulation* (*I*) — resistance to temperature rise on the unexposed face up to a maximum of 180°C at any single point and average temperature of 140°C.

NOTE — *See also* **4.9**.

4.22 Fire Separation — The distance, in metres, measured from the external wall of the building concerned to the external wall of any other building on the site, or from other site, or from the opposite side of street or other public space for the purpose of preventing the spread of fire.

4.23 Float Glass — Flat, transparent, clear or tinted soda-lime silicate glass having parallel and polished surfaces obtained by casting and floatation on a metal bath.

NOTE — Flat glass is a general term covering sheet glass, float glass and various forms of rolled and plate glass in which shape of the glass is flat and commonly used for windows, glass doors, transparent walls and other architectural applications.

4.24 Flush Over Panel — A panel which is incorporated within a door-set or openable window and fitted above the leaf or leaves within the frame head and the jambs and with no transom.

4.25 Frame — An element made of timber/metal/aluminium or other durable material/combination of materials, such as glass fins and structural sealant, supporting the full length of a glazed panel edge.

4.26 Frameless Glazing — An unframed glazing which maintains the integrity through pointed support structures.

4.27 Front Putty — The compound forming a triangular fillet between the surface of glass and the front edge of rebate.

4.28 Fully Framed Glazing — The glazing whose panels have all its four edges framed.

4.29 Gap — A clearance between two adjacent surfaces and/or edges, for example between the edge of the leaf and the reveal of the frame or between the face of the leaf and the frame stop.

4.30 Glass — An inorganic, non-metallic material produced by the complete fusion of raw materials at high temperatures, into a homogenous liquid which is then cooled to a rigid condition without crystallizing. It is typically hard and brittle, and has a conchoidal fracture. It may be colourless or tinted and transparent to opaque. The term glass refers to monolithic glass unless specified otherwise.

4.31 Glazing — Act of securing of glass or other glazing material into a building in prepared openings in windows, door panels, partitions, etc.

4.32 Heat Soaking — It is done on toughened/ tempered glass by reheating to a temperature of 290°C and keeping it at this temperature for 8 h and cooling it gradually. The glass can break spontaneously and without provocation due to possible impurity of nickel sulphide in basic glass used for toughening/tempering. This risk of spontaneous breakage can be minimized by heat soaking process by forcing such glasses to break during the test itself.

4.33 Heat Strengthened Glass — Glass within which a permanent surface compressive stress, additionally to the basic mechanical strength, has been induced by a controlled heating and cooling process in order to give it increased resistance to mechanical and thermal stress and prescribed fracture characteristics.

4.34 Hermetic Seal — A complete seal (especially against the escape or entry of air which is impervious to outside interference or influence) done on insulating glass units.

4.35 Infill Balustrades — The balustrades in which the supported glass resists an infill pressure and/or point load applied to the glass panel.

4.36 Insulating Glass Unit (IGU) — An assembly consisting of at least two panes of glass, separated by one or more spaces, hermetically sealed along the periphery, mechanically stable and durable.

4.37 Interlayer — Layer or material acting as an adhesive and separator between plies of glass and/or plastic glazing sheets.

NOTE — It can be designed to give additional performance to the finished product, for example impact resistance, fire resistance, solar control and acoustic insulation

4.38 Laminated Safety Glass — A glass made of two or more pieces of glass which are held together by an interleaving layer or layers of plastic materials.

4.39 Non-Combustible Material — A material not liable to burn itself or to add heat to a fire when tested for combustibility in accordance with IS/ISO 834-1.

4.40 Organic Coated Glass — A sheet of glass coated on one or both sides with an applied organic coating or sheeting.

4.41 Rebate — The part of a surround; the cross-section of which forms an angle into which the edge of the glass is received.

4.42 Sheet Glass — Glass made in large sheet directly from furnace or by making a cylinder and then flattening it.

NOTE — These transparent glass have a glossy, fire-finished, apparently plane and smooth surfaces, but having a characteristic waviness of surface.

4.43 Tempered Fire Resistant Glass — A single piece of specially thermally-treated glass, tested for fire resistance for the required duration and having such a stress pattern that the piece when fractured, it reduces to numerous granular fragments, with no large jagged edges.

4.44 Toughened (Tempered) Safety Glass — A single piece of specially heat treated glass, with a stress pattern such that the piece when fractured reduces to numerous granular fragments, with no large jagged edges.

4.45 Tinted Glass — A normal flat glass to which colourants (normally metal oxides) are added during manufacturing process to achieve tinting and solar radiation absorption properties. It is also referred to as body tinted glass.

4.46 Unframed Glazing — A glazing with one or more edges unframed.

4.47 Wired Glass — It is a type of glass into which a wire mesh is embedded during production. Wired glass has an impact resistance similar to that of normal glass, but in case of breakage, the mesh retains the pieces of glass.

5 DETERMINATION OF APPROPRIATE GLASS THICKNESS

5.1 General

This standard gives provisions to determine the minimum glass thickness to be used to resist the ultimate limit state design wind pressures. However, the location of the glass within a building requires additional considerations, such as safety with respect to human which may impose either a minimum glass thickness above the basic calculation of this part or a provision for a specific glass type or both.

In addition to the provisions herein, the design requirements such as wind loads determined in accordance with IS 875 (Part 3), and the serviceability deflection requirement limit given in this standard shall have to be complied.

The provisions of this standard are applicable provided the following parameters are satisfied:

a) Ultimate limit state wind pressure shall not be greater than 10 kPa.

b) For laminated glass, the two sheets are of equal thickness and the interlayer material is either polyvinyl butyral (PVB) or an equivalent type of interlayer with a modulus of elasticity of about 24 MPa and a Poisson's ratio of 0.50 at 20 °C. *See* Annex B for information regarding effective thickness of laminated glass. Suitable precaution needs to be taken as exposed edges of laminated glass to environment can lead to delamination.

c) Design flexural tensile strength of glass depends upon the ultimate limit state design strength obtained after applying a factor of safety of 2.5. The minimum design strength of normal glass for thickness up to 6 mm is 16.7 N/mm^2 and for thickness above 6 mm is 15.2 N/mm^2.

5.2 Design Considerations

The following design considerations shall be considered in determination of appropriate thickness of glass:

a) Maximum area of glass panel is restricted to 15 m^2.

b) Maximum span of window is restricted to 4 m.

c) Aspect ratio of the glass panel should be greater than 1.5. If it is less than 1.5, next higher available thickness should be selected in order to reduce the stress level.

d) Factor of safety used is 2.5 considering the variability in strength of glass.

e) Applicable to normal, reflective, laminated, tempered and insulating glass.

f) Applicable to rectangular panels properly secured.

g) Design minimum thickness of laminated glass will be the maximum value of thickness in accordance with the Table 5 of IS 16231 (Part 1).

h) Any recognized method of analysis may be used for design, in consultation with the manufacturer.

j) Temperature of the ambience (if laminated glass is used).

5.3 Empirical Relationship

Empirical relation between the wind pressure, area of the glass panel and the required glass thickness can be used:

$P_{net}.A = 200T^k$ (for $T < 6$ mm)

$P_{net}.A = 200T^k + 1\,900$ (for $T > 6$ mm)

where,

P_{net} = net design wind pressure as per **5.4**, in N/m^2;

A = area of glass panel, in m^2;

T = standard nominal thickness (SNT) of glass from Table 1, in mm; and

k = constant from Table 1.

5.3.1 *Glass Supported on Two Opposite Sides*

a) Normal and laminated glass panels supported on two opposite sides can be designed using following empirical relations:

1) For $T \leq 6$ mm :

$$b = \frac{4.39\,T}{\sqrt{\left(\frac{P_{net}}{P_f}\right)}}$$

2) For $T > 6$ mm :

$$b = \frac{4.22\,T}{\sqrt{\left(\frac{P_{net}}{P_f}\right)}}$$

b) Tempered/toughened panel supported on two opposite sides can be designed using following empirical relations:

1) For $T \leq 6$ mm :

$$b = \frac{3.268\,8\,T}{\sqrt{\left(\frac{P_{net}}{P_f}\right)}}$$

2) For $T > 6$ mm :

$$b = \frac{2.906\,9\,T}{\sqrt{\left(\frac{P_{net}}{P_f}\right)}}$$

Table 1 Value of k for the Corresponding Standard Nominal Thickness of Float Glass

(*Clause* 5.3)

T, mm	3	4	5	6	8	10	12	15	19	25
k	1.683	1.732	1.753	1.765	1.57	1.578	1.583	1.579	1.569	1.569

where

b = span, in m; and

P_f = strength factors as in Table 2.

For insulated glass, thickness of only one glass pane shall be considered. If the glass panes are of different thickness, the minimum of the two thicknesses shall be considered.

For laminated glass, the thickness of PVB has not been considered. The value to be used is:

T = Standard nominal thickness – Thickness of PVB

For non-linear analysis, specialist literature may be consulted.

5.4 Determination of Design Wind Pressure

Net design wind pressure (P_{net}) is an important parameter governing the thickness of glass to be used in the window panels. It depends on factors as given below:

a) Location of the building (wind zone);

b) Construction patterns around buildings (terrain category);

c) Topography of site;

d) Building plan and height, etc.

Net design wind pressure (P_{net}), may be defined using the following equation:

$$P_{net} = p_z.C_p$$

where

C = net pressure coefficient as per IS 875 (Part 3); and

p_z = design wind pressure as per IS 875 (Part 3), in N/m^2.
$= 0.6\ V_z^2$

$$V_z = V_b.k_1.k_2.k_3.k_4$$

where

V_b = basic wind speed based on location [as per Fig. 1 of IS 875 (Part 3)];

k_1 = risk co-efficient factor;

k_2 = terrain factor;

k_3 = topography factor;

k_4 = importance factor for the cyclonic region; and

V_z = design wind speed, in m/s.

5.4.1 *Laminated/ Tempered/ Insulating Glass*

To determine the thickness of laminated/tempered/insulating glass, the design wind pressure P_{net} is modified by dividing it with the strength or pressure factor P_f, dependent on the type of glass. The values of the P_f are given in Table 2.

Using the modified values of P_{net}, the thickness of other glass types can be obtained in accordance with **5.3**.

Table 2 Strength Factor, P_f

[*Clauses* 5.3.1(b) 5.4.1]

Sl No. (1)	Glass Type (2)	P_f (3)
i)	Normal (Annealed)	1.00
ii)	Laminated	0.80
iii)	Tempered	2.50
iv)	Insulated	1.50
v)	Heat strengthened	1.60
vi)	Wired glass	0.50

5.5 Aspect Ratio (ARmax)

The design of the thickness using empirical relation in accordance with **5.3** shall be valid up to a limiting aspect ratio AR_{max}. The value of AR_{max} for different thickness (T) of glass is given in Table 3.

5.6 Seismic Design

5.6.1 *Seismic Load (EQ)*

The design for seismic forces shall be performed in steps to establish upper and lower bound force and movement response parameters. In addition, the response of the structure sensitive to certain parameters such as the damping and the stiffness of the support points may be evaluated.

The principal design criteria for the seismic design are:

a) Structure will remain elastic during the design seismic event;

b) Hangers (that support the glass assembly to the building structure) will stiffen the cantilever 'tree' structure; and

c) Hangers will not go slack.

Table 3 Thickness and Corresponding AR_{max} Values

(*Clause* 5.5)

T, mm	3	4	5	6	8	10	12	15	19	25
AR_{max}	7.3	6.8	6.5	6.3	5.9	4.9	4.3	3.8	3.3	2.9

5.6.2 *Non-structural Elements*

Depending on response sensitivity, non-structural elements can be classified as deformation sensitive, acceleration sensitive, or both deformation and acceleration sensitive. Table 4 classifies non-structural elements according to their response sensitivity.

Table 4 Response Sensitivity of Architectural Component

(*Clause* 5.6.2)

Sl No.	Component	Sensitivity	
		Acceleration Sensitive	Deformation Sensitive
(1)	(2)	(3)	(4)
i)	Exterior skin:		
	a) Adhered veneer	S	P
	b) Anchored veneer	S	P
	c) Glass blocks	S	P
	d) Prefabricated panel	S	P
	e) Glazing system	S	P
ii)	Partitions:		
	a) Heavy	S	P
	b) Light	S	P
iii)	Interior veneers:		
	a) Stone, including marble	S	P
	b) Ceramic tile	S	P
iv)	Parapets and appendages	P	—
v)	Canopies and marquees	P	—
vi)	Stairs	P	S

NOTES

1 P = Primary response.

2 S = Secondary response.

5.6.3 *Design Seismic Force*

Design seismic force, F_p, on the non-structural element shall be calculated using the following expression:

$$F_p = \frac{Z}{2}\left(1 + \frac{x}{h}\right)\frac{a_p}{R_p} I_p W_p$$

$$\geq 0.10 W_p$$

where

Z = zone factor [as per Table 2 of IS 1893 (Part 1)];

x = height of point of attachment of the non-structural element above the foundation;

h = height of the structure;

a_p = component amplification factor given in Table 5;

R_p = component response factor of the non-structural modification factor given in Table 5;

I_p = importance element (to be taken as 1.5); and

W_p = weight of the non-structural element.

5.6.4 *Seismic Relative Displacement*

a) For two connection points on the same structure '*A*', one at a height h_x, and other at a height h_y, seismic relative displacement shall be determined as:

$$D_p = \delta_{xA} - \delta_{yA}$$

D_p is not required to be taken as greater than

$$R(h_x - h_y)\frac{\Delta_{aA}}{h_{sx}}$$

where

δ_{xA} = deflection at building level x of structure A due to design seismic load determined by elastic analysis, and multiplied by response reduction factor R of the building as per Table 9 of IS 1893 (Part 1);

Δ_{yA} = deflection at building level y of structure A due to design seismic load determined by elastic analysis, and multiplied by response reduction factor R of the building as per Table 9 of IS 1893 (Part 1);

h_x = height of level x to which upper connection point is attached;

h_y = height of level y to which lower connection point is attached;

Δ_{aA} = allowable storey drift for structure A calculated as per **7.11.1.1** of IS 1893 (Part 1); and

h_{sx} = storey height below level x.

b) For two connection points on separate structures *A* and *B*, or separate structural systems, one at height, h_x, and the other at a height, h_y , D_p shall be determined as:

$$D_p = |\delta_{xA}| + |\delta_{yA}|$$

D_p is not required to be taken as greater than

$$R\left(h_x \frac{\Delta_{aA}}{h_{sx}} + h_y \frac{\Delta_{aB}}{h_{sx}}\right)$$

where

δ_{yB} = deflection at building level y of structure *B* due to design seismic load determined by elastic analysis, and multiplied by response reduction factor, *R*, of the building as per Table 9 of IS 1893 (Part 1).

Δ_{aB} = allowable storey drift for structure *B* calculated as per **7.11.1.1** of IS 1893 (Part 1)

Table 5 Modification Factors

(*Clause* 5.6.3)

Sl No.	Architectural Component or Element	a_p (*see* Note)	R_p
(1)	(2)	(3)	(4)
i)	Interior non-structural walls and partitions:		
	a) Plain (unreinforced) masonry walls	1.0	1.5
	b) All other walls and partitions	1.0	2.5
ii)	Cantilever elements (braced to structural frame above its centre of mass):		
	a) Parapets	1.0	1.5
	b) Chimneys and stacks	1.0	2.5
	c) Exterior non-structural walls	1.0	2.5
iii)	Exterior non-structural wall elements and connections:		
	a) Wall element	1.0	2.5
	b) Body of wall panel connection	1.0	2.5
	c) Fasteners of the connecting system	1.25	1.0
iv)	Veneer:		
	a) High deformability elements and attachments	1.0	2.5
	b) Low deformability elements and attachments	1.0	1.5

NOTE — A lower value of a_p is permitted provided a detailed dynamic analysis is performed which justifies a lower value. The value of a_p shall not be less than 1.0. The value of a_p = 1.0 is for equipment generally regarded as rigid and rigidly attached. The value of a_p = 2.5 is for flexible components or flexibly attached components.

5.7 Imposed Loads

The uniform distributed load and point load is to be considered based on application and is to be selected in accordance with IS 875 (Part 2). Appropriate uniform distributed load (UDL) and concentrated load are selected in accordance to IS 875 (Part 2), based on nature of building (for example, residential, institutional, industrial building, etc) and nature of activity under each building type.

5.8 Load Contribution

5.8.1 *Wind Load*

The wind load is the effect of wind pressure which is dependent on the location, building height, topography and ground roughness factor. The wind speed is taken from IS 875 (Part 3), for the geographic location.

5.8.2 *Dead Load*

In case of inclined sloped glazing, the dead weight of the glazing should be considered. In case of component of sloped glazing, the following corresponding component of the total glazing may be used:

a) Point load shall be applied as a uniformly distributed load over a circular area of 0.01 m^2.

b) For a glazed panel supported on all edges, the point loading shall be applied at the centre.

c) For free glazing edges, the point load shall be applied adjacent to the centre of the free edge.

d) Ultimate limit state design wind pressure shall not be greater than 1.2 kPa. For greater design wind pressures, the glass shall be separately designed to withstand wind loading in accordance with **5.4**.

5.9 Reference Chart Relating Wind Load, Maximum Allowable Area for a Thickness of Glass with Respect to Terrain Category

Table 6 to Table 14 provides relation between design wind pressure and maximum allowable area for a thickness of glass with respect to specific terrain category. User may select the type of glass depending on the support conditions.

Specialist literature may be consulted for use of non-linear analysis and the like for laminated glass.

The deflection at the centre of glass pane can be calculated using the formula in accordance to Annex C.

Typical model calculation to calculate thickness and determine wind load and deflection at the centre of the glazing is given at Annex D.

6 INSTALLATION

6.1 The basic installation requirements and materials used for glass are given hereunder.

NOTES

1 The provisions under this item do not include the use of other methods or systems for glazing, provided the alternate method or system can be demonstrated to satisfy the requirements for correctly supporting the glass within the frame, or glazing system.

2 Patent and other proprietary systems are not described/ covered here.

3 Installation technique for frameless glazing system is not covered here.

6.2 Site Working and Glass Machining Operation

Heat-strengthened and toughened glass shall not be cut or worked after heat treatment. All necessary cutting, drilling, notching and edge-working shall be carried out to correct dimensions prior to value addition to the glass, such as toughening/ tempering/ heat strengthening. The edges and surfaces of all glass types shall not be damaged during fixing.

6.3 Dimensional Requirement

The dimensions for edge clearance, edge cover, front and back clearance, rebate depth is selected in accordance with the requirements in **9.2** of IS 16231 (Part 1).

6.4 Glazing Materials

6.4.1 *Compatibility of Materials*

A glazing material shall be used only when compatible with contiguous materials, including the rebate surface finish, setting or location blocks, distance pieces and glass type are available.

6.4.2 *Application of Materials*

The application of glazing materials shall be in accordance with relevant/available Indian Standard or manufacturer's recommendations.

6.4.3 *Life Expectancy of Materials*

A glazing material shall only be used where its life expectancy (durability) has been established. The manufacturer's advice/guarantee should be sought for information regarding life expectancy.

Table 6 Maximum Areas for Annealed Glass Fixed on All Four Sides, m^2

(*Clause* 5.9)

Design Wind Pressure N/m^2	Nominal Thickness of Glass, T mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	2.13	3.86	6.03	8.63	13.06	15.00	15.00	15.00	15.00
550	1.93	3.51	5.48	7.85	11.88	15.00	15.00	15.00	15.00
600	1.77	3.21	5.02	7.19	10.89	14.61	15.00	15.00	15.00
650	1.64	2.97	4.64	6.64	10.05	13.48	15.00	15.00	15.00
700	1.52	2.75	4.31	6.17	9.33	12.52	15.00	15.00	15.00
750	1.42	2.57	4.02	5.76	8.71	11.69	14.75	15.00	15.00
800	1.33	2.41	3.77	5.40	8.16	10.96	13.83	15.00	15.00
850	1.25	2.27	3.55	5.08	7.68	10.31	13.01	15.00	15.00
900	1.18	2.14	3.35	4.80	7.26	9.74	12.29	15.00	15.00
950	1.12	2.03	3.17	4.54	6.88	9.23	11.64	15.00	15.00
1 000	1.06	1.93	3.01	4.32	6.53	8.76	11.06	15.00	15.00
1 050	1.01	1.84	2.87	4.11	6.22	8.35	10.53	14.38	15.00
1 100	0.97	1.75	2.74	3.92	5.94	7.97	10.06	13.73	15.00
1 150	0.93	1.68	2.62	3.75	5.68	7.62	9.62	13.13	15.00
1 200	0.89	1.61	2.51	3.60	5.44	7.30	9.22	12.58	15.00
1 250	0.85	1.54	2.41	3.45	5.23	7.01	8.85	12.08	15.00
1 300	0.82	1.48	2.32	3.32	5.02	6.74	8.51	11.61	15.00
1 350	0.79	1.43	2.23	3.20	4.84	6.49	8.19	11.18	14.98
1 400	0.76	1.38	2.15	3.08	4.67	6.26	7.90	10.78	14.44
1 450	0.73	1.33	2.08	2.98	4.50	6.04	7.63	10.41	13.95
1 500	0.71	1.29	2.01	2.88	4.35	5.84	7.37	10.07	13.48
1 550	0.69	1.24	1.94	2.78	4.21	5.65	7.14	9.74	13.05
1 600	0.67	1.21	1.88	2.70	4.08	5.48	6.91	9.44	12.64
1 650	0.64	1.17	1.83	2.62	3.96	5.31	6.70	9.15	12.25
1 700	0.63	1.13	1.77	2.54	3.84	5.16	6.51	8.88	11.89
1 750	0.61	1.10	1.72	2.47	3.73	5.01	6.32	8.63	11.55
1 800	0.59	1.07	1.67	2.40	3.63	4.87	6.14	8.39	11.23
1 850	0.58	1.04	1.63	2.33	3.53	4.74	5.98	8.16	10.93
1 900	0.56	1.01	1.59	2.27	3.44	4.61	5.82	7.95	10.64
1 950	0.55	0.99	1.55	2.21	3.35	4.49	5.67	7.74	10.37
2 000	0.53	0.96	1.51	2.16	3.27	4.38	5.53	7.55	10.11
2 050	0.52	0.94	1.47	2.11	3.19	4.28	5.40	7.36	9.86
2 100	0.51	0.92	1.44	2.06	3.11	4.17	5.27	7.19	9.63
2 150	0.49	0.90	1.40	2.01	3.04	4.08	5.14	7.02	9.40
2 200	0.48	0.88	1.37	1.96	2.97	3.98	5.03	6.86	9.19

Table 6 (*Continued*)

Design Wind Pressure N/m²	**Nominal Thickness of Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 250	0.47	0.86	1.34	1.92	2.90	3.90	4.92	6.71	8.99
2 300	0.46	0.84	1.31	1.88	2.84	3.81	4.81	6.56	8.79
2 350	0.45	0.82	1.28	1.84	2.78	3.73	4.71	6.42	8.60
2 400	0.44	0.80	1.26	1.80	2.72	3.65	4.61	6.29	8.43
2 450	0.43	0.79	1.23	1.76	2.67	3.58	4.51	6.16	8.25
2 500	0.43	0.77	1.21	1.73	2.61	3.51	4.42	6.04	8.09
2 550	0.42	0.76	1.18	1.69	2.56	3.44	4.34	5.92	7.93
2 600	0.41	0.74	1.16	1.66	2.51	3.37	4.25	5.81	7.78
2 650	0.40	0.73	1.14	1.63	2.46	3.31	4.17	5.70	7.63
2 700	0.39	0.71	1.12	1.60	2.42	3.25	4.10	5.59	7.49
2 750	0.39	0.70	1.10	1.57	2.38	3.19	4.02	5.49	7.35
2 800	0.38	0.69	1.08	1.54	2.33	3.13	3.95	5.39	7.22
2 850	0.37	0.68	1.06	1.51	2.29	3.08	3.88	5.30	7.09
2 900	0.37	0.66	1.04	1.49	2.25	3.02	3.81	5.21	6.97
2 950	0.36	0.65	1.02	1.46	2.21	2.97	3.75	5.12	6.85
3 000	0.35	0.64	1.00	1.44	2.18	2.92	3.69	5.03	6.74
3 050	0.35	0.63	0.99	1.42	2.14	2.87	3.63	4.95	6.63
3 100	0.34	0.62	0.97	1.39	2.11	2.83	3.57	4.87	6.52
3 150	0.34	0.61	0.96	1.37	2.07	2.78	3.51	4.79	6.42
3 200	0.33	0.60	0.94	1.35	2.04	2.74	3.46	4.72	6.32
3 250	0.33	0.59	0.93	1.33	2.01	2.70	3.40	4.65	6.22
3 300	0.32	0.58	0.91	1.31	1.98	2.66	3.35	4.58	6.13
3 350	0.32	0.58	0.90	1.29	1.95	2.62	3.30	4.51	6.04
3 400	0.31	0.57	0.89	1.27	1.92	2.58	3.25	4.44	5.95
3 450	0.31	0.56	0.87	1.25	1.89	2.54	3.21	4.38	5.86
3 500	0.30	0.55	0.86	1.23	1.87	2.50	3.16	4.31	5.78
3 550	0.30	0.54	0.85	1.22	1.84	2.47	3.12	4.25	5.70
3 600	0.30	0.54	0.84	1.20	1.81	2.43	3.07	4.19	5.62
3 650	0.29	0.53	0.83	1.18	1.79	2.40	3.03	4.14	5.54
3 700	0.29	0.52	0.81	1.17	1.77	2.37	2.99	4.08	5.47
3 750	0.28	0.51	0.80	1.15	1.74	2.34	2.95	4.03	5.39
3 800	0.28	0.51	0.79	1.14	1.72	2.31	2.91	3.97	5.32
3 850	0.28	0.50	0.78	1.12	1.70	2.28	2.87	3.92	5.25
3 900	0.27	0.49	0.77	1.11	1.67	2.25	2.84	3.87	5.18
3 950	0.27	0.49	0.76	1.09	1.65	2.22	2.80	3.82	5.12
4 000	0.27	0.48	0.75	1.08	1.63	2.19	2.77	3.77	5.06
4 050	0.26	0.48	0.74	1.07	1.61	2.16	2.73	3.73	4.99

Table 6 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 100	0.26	0.47	0.74	1.05	1.59	2.14	2.70	3.68	4.93
4 150	0.26	0.46	0.73	1.04	1.57	2.11	2.67	3.64	4.87
4 200	0.25	0.46	0.72	1.03	1.56	2.09	2.63	3.59	4.81
4 250	0.25	0.45	0.71	1.02	1.54	2.06	2.60	3.55	4.76
4 300	0.25	0.45	0.70	1.00	1.52	2.04	2.57	3.51	4.70
4 350	0.24	0.44	0.69	0.99	1.50	2.01	2.54	3.47	4.65
4 400	0.24	0.44	0.69	0.98	1.48	1.99	2.51	3.43	4.60
4 450	0.24	0.43	0.68	0.97	1.47	1.97	2.49	3.39	4.54
4 500	0.24	0.43	0.67	0.96	1.45	1.95	2.46	3.36	4.49
4 550	0.23	0.42	0.66	0.95	1.44	1.93	2.43	3.32	4.44
4 600	0.23	0.42	0.66	0.94	1.42	1.91	2.40	3.28	4.40
4 650	0.23	0.41	0.65	0.93	1.40	1.88	2.38	3.25	4.35
4 700	0.23	0.41	0.64	0.92	1.39	1.86	2.35	3.21	4.30
4 750	0.22	0.41	0.63	0.91	1.38	1.85	2.33	3.18	4.26
4 800	0.22	0.40	0.63	0.90	1.36	1.83	2.30	3.15	4.21
4 850	0.22	0.40	0.62	0.89	1.35	1.81	2.28	3.11	4.17
4 900	0.22	0.39	0.62	0.88	1.33	1.79	2.26	3.08	4.13
4 950	0.21	0.39	0.61	0.87	1.32	1.77	2.23	3.05	4.08
5 000	0.21	0.39	0.60	0.86	1.31	1.75	2.21	3.02	4.04
Maximum aspect ratio	7.3	6.8	6.5	6.3	5.9	4.9	4.3	3.8	3.3

Table 7 Maximum Areas for Laminated Glass Fixed on All Four Sides, m^2

(*Clause* 5.9)

Design Wind Pressure N/m^2	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
500	4.47	6.28	10.45	14.02	15.00	15.00
550	4.06	5.71	9.50	12.75	15.00	15.00
600	3.72	5.23	8.71	11.69	15.00	15.00
650	3.44	4.83	8.04	10.79	13.93	15.00
700	3.19	4.48	7.46	10.02	12.94	15.00
750	2.98	4.19	6.97	9.35	12.08	15.00
800	2.79	3.92	6.53	8.76	11.32	15.00
850	2.63	3.69	6.15	8.25	10.66	15.00
900	2.48	3.49	5.81	7.79	10.06	14.21
950	2.35	3.30	5.50	7.38	9.53	13.46
1 000	2.23	3.14	5.23	7.01	9.06	12.79
1 050	2.13	2.99	4.98	6.68	8.63	12.18
1 100	2.03	2.85	4.75	6.37	8.23	11.63
1 150	1.94	2.73	4.54	6.10	7.88	11.12
1 200	1.86	2.62	4.35	5.84	7.55	10.66
1 250	1.79	2.51	4.18	5.61	7.25	10.23
1 300	1.72	2.41	4.02	5.39	6.97	9.84
1 350	1.66	2.33	3.87	5.19	6.71	9.47
1 400	1.60	2.24	3.73	5.01	6.47	9.14
1 450	1.54	2.16	3.60	4.84	6.25	8.82
1 500	1.49	2.09	3.48	4.67	6.04	8.53
1 550	1.44	2.03	3.37	4.52	5.84	8.25
1 600	1.40	1.96	3.27	4.38	5.66	7.99
1 650	1.35	1.90	3.17	4.25	5.49	7.75
1 700	1.31	1.85	3.07	4.12	5.33	7.52
1 750	1.28	1.79	2.99	4.01	5.18	7.31
1 800	1.24	1.74	2.90	3.90	5.03	7.11
1 850	1.21	1.70	2.82	3.79	4.90	6.91
1 900	1.18	1.65	2.75	3.69	4.77	6.73
1 950	1.15	1.61	2.68	3.60	4.64	6.56
2 000	1.12	1.57	2.61	3.51	4.53	6.40
2 050	1.09	1.53	2.55	3.42	4.42	6.24
2 100	1.06	1.49	2.49	3.34	4.31	6.09
2 150	1.04	1.46	2.43	3.26	4.21	5.95
2 200	1.02	1.43	2.38	3.19	4.12	5.81
2 250	0.99	1.40	2.32	3.12	4.03	5.68

Table 7 (*Continued*)

Design Wind Pressure N/m^2	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2 300	0.97	1.36	2.27	3.05	3.94	5.56
2 350	0.95	1.34	2.22	2.98	3.85	5.44
2 400	0.93	1.31	2.18	2.92	3.77	5.33
2 450	0.91	1.28	2.13	2.86	3.70	5.22
2 500	0.89	1.26	2.09	2.80	3.62	5.12
2550	0.88	1.23	2.05	2.75	3.55	5.02
2 600	0.86	1.21	2.01	2.70	3.48	4.92
2 650	0.84	1.18	1.97	2.65	3.42	4.83
2 700	0.83	1.16	1.94	2.60	3.35	4.74
2 750	0.81	1.14	1.90	2.55	3.29	4.65
2 800	0.80	1.12	1.87	2.50	3.23	4.57
2 850	0.78	1.10	1.83	2.46	3.18	4.49
2 900	0.77	1.08	1.80	2.42	3.12	4.41
2 950	0.76	1.06	1.77	2.38	3.07	4.34
3 000	0.74	1.05	1.74	2.34	3.02	4.26
3 050	0.73	1.03	1.71	2.30	2.97	4.19
3 100	0.72	1.01	1.69	2.26	2.92	4.13
3 150	0.71	1.00	1.66	2.23	2.88	4.06
3 200	0.70	0.98	1.63	2.19	2.83	4.00
3 250	0.69	0.97	1.61	2.16	2.79	3.94
3 300	0.68	0.95	1.58	2.12	2.74	3.88
3 350	0.67	0.94	1.56	2.09	2.70	3.82
3 400	0.66	0.92	1.54	2.06	2.66	3.76
3 450	0.65	0.91	1.51	2.03	2.63	3.71
3 500	0.64	0.90	1.49	2.00	2.59	3.65
3 550	0.63	0.88	1.47	1.98	2.55	3.60
3 600	0.62	0.87	1.45	1.95	2.52	3.55
3 650	0.61	0.86	1.43	1.92	2.48	3.50
3 700	0.60	0.85	1.41	1.90	2.45	3.46
3 750	0.60	0.84	1.39	1.87	2.42	3.41
3 800	0.59	0.83	1.38	1.85	2.38	3.37
3 850	0.58	0.82	1.36	1.82	2.35	3.32
3 900	0.57	0.80	1.34	1.80	2.32	3.28
3 950	0.57	0.79	1.32	1.78	2.29	3.24
4 000	0.56	0.78	1.31	1.75	2.26	3.20
4 050	0.55	0.78	1.29	1.73	2.24	3.16
4 100	0.55	0.77	1.27	1.71	2.21	3.12

Table 7 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4 150	0.54	0.76	1.26	1.69	2.18	3.08
4 200	0.53	0.75	1.24	1.67	2.16	3.05
4 250	0.53	0.74	1.23	1.65	2.13	3.01
4 300	0.52	0.73	1.22	1.63	2.11	2.97
4 350	0.51	0.72	1.20	1.61	2.08	2.94
4 400	0.51	0.71	1.19	1.59	2.06	2.91
4 450	0.50	0.71	1.17	1.58	2.04	2.87
4 500	0.50	0.70	1.16	1.56	2.01	2.84
4 550	0.49	0.69	1.15	1.54	1.99	2.81
4 600	0.49	0.68	1.14	1.52	1.97	2.78
4 650	0.48	0.68	1.12	1.51	1.95	2.75
4 700	0.48	0.67	1.11	1.49	1.93	2.72
4 750	0.47	0.66	1.10	1.48	1.91	2.69
4 800	0.47	0.65	1.09	1.46	1.89	2.66
4 850	0.46	0.65	1.08	1.45	1.87	2.64
4 900	0.46	0.64	1.07	1.43	1.85	2.61
4 950	0.45	0.63	1.06	1.42	1.83	2.58
5 000	0.45	0.63	1.05	1.40	1.81	2.56
Maximum aspect ratio	6.5	6.2	5.7	4.8	4.3	3.6

Table 8 Maximum Areas for Tempered Glass Fixed on All Four Sides, m^2

(*Clause* 5.9)

Design Wind Pressure N/m^2	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	5.32	9.64	15.00	15.00	15.00	15.00	15.00	15.00	15.00
550	4.84	8.76	13.70	15.00	15.00	15.00	15.00	15.00	15.00
600	4.43	8.03	12.56	15.00	15.00	15.00	15.00	15.00	15.00
650	4.09	7.42	11.59	15.00	15.00	15.00	15.00	15.00	15.00
700	3.80	6.89	10.77	15.00	15.00	15.00	15.00	15.00	15.00
750	3.55	6.43	10.05	14.39	15.00	15.00	15.00	15.00	15.00
800	3.33	6.03	9.42	13.49	15.00	15.00	15.00	15.00	15.00
850	3.13	5.67	8.87	12.70	15.00	15.00	15.00	15.00	15.00
900	2.96	5.36	8.37	11.99	15.00	15.00	15.00	15.00	15.00
950	2.80	5.07	7.93	11.36	15.00	15.00	15.00	15.00	15.00
1 000	2.66	4.82	7.54	10.79	15.00	15.00	15.00	15.00	15.00
1 050	2.53	4.59	7.18	10.28	15.00	15.00	15.00	15.00	15.00
1 100	2.42	4.38	6.85	9.81	14.84	15.00	15.00	15.00	15.00
1 150	2.31	4.19	6.55	9.38	14.20	15.00	15.00	15.00	15.00
1 200	2.22	4.02	6.28	8.99	13.61	15.00	15.00	15.00	15.00
1 250	2.13	3.86	6.03	8.63	13.06	15.00	15.00	15.00	15.00
1 300	2.05	3.71	5.80	8.30	12.56	15.00	15.00	15.00	15.00
1 350	1.97	3.57	5.58	7.99	12.10	15.00	15.00	15.00	15.00
1 400	1.90	3.44	5.38	7.71	11.66	15.00	15.00	15.00	15.00
1 450	1.83	3.32	5.20	7.44	11.26	15.00	15.00	15.00	15.00
1 500	1.77	3.21	5.02	7.19	10.89	14.61	15.00	15.00	15.00
1 550	1.72	3.11	4.86	6.96	10.53	14.14	15.00	15.00	15.00
1 600	1.66	3.01	4.71	6.74	10.21	13.69	15.00	15.00	15.00
1 650	1.61	2.92	4.57	6.54	9.90	13.28	15.00	15.00	15.00
1 700	1.56	2.84	4.43	6.35	9.61	12.89	15.00	15.00	15.00
1 750	1.52	2.75	4.31	6.17	9.33	12.52	15.00	15.00	15.00
1 800	1.48	2.68	4.19	6.00	9.07	12.17	15.00	15.00	15.00
1 850	1.44	2.61	4.07	5.83	8.83	11.84	14.95	15.00	15.00
1 900	1.40	2.54	3.97	5.68	8.59	11.53	14.55	15.00	15.00
1 950	1.36	2.47	3.86	5.53	8.37	11.24	14.18	15.00	15.00
2 000	1.33	2.41	3.77	5.40	8.16	10.96	13.83	15.00	15.00
2 050	1.30	2.35	3.68	5.26	7.97	10.69	13.49	15.00	15.00
2 100	1.27	2.30	3.59	5.14	7.78	10.43	13.17	15.00	15.00
2 150	1.24	2.24	3.51	5.02	7.59	10.19	12.86	15.00	15.00
2 200	1.21	2.19	3.43	4.91	7.42	9.96	12.57	15.00	15.00
2 250	1.18	2.14	3.35	4.80	7.26	9.74	12.29	15.00	15.00

Table 8 (*Continued*)

Design Wind Pressure N/m^2	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 300	1.16	2.10	3.28	4.69	7.10	9.53	12.02	15.00	15.00
2 350	1.13	2.05	3.21	4.59	6.95	9.32	11.77	15.00	15.00
2 400	1.11	2.01	3.14	4.50	6.80	9.13	11.52	15.00	15.00
2 450	1.09	1.97	3.08	4.40	6.66	8.94	11.29	15.00	15.00
2 500	1.06	1.93	3.01	4.32	6.53	8.76	11.06	15.00	15.00
2 550	1.04	1.89	2.96	4.23	6.40	8.59	10.84	14.80	15.00
2 600	1.02	1.85	2.90	4.15	6.28	8.43	10.64	14.52	15.00
2 650	1.00	1.82	2.84	4.07	6.16	8.27	10.43	14.24	15.00
2 700	0.99	1.79	2.79	4.00	6.05	8.12	10.24	13.98	15.00
2 750	0.97	1.75	2.74	3.92	5.94	7.97	10.06	13.73	15.00
2 800	0.95	1.72	2.69	3.85	5.83	7.83	9.88	13.48	15.00
2 850	0.93	1.69	2.64	3.79	5.73	7.69	9.70	13.24	15.00
2 900	0.92	1.66	2.60	3.72	5.63	7.56	9.54	13.02	15.00
2 950	0.90	1.63	2.55	3.66	5.54	7.43	9.37	12.79	15.00
3 000	0.89	1.61	2.51	3.60	5.44	7.30	9.22	12.58	15.00
3 050	0.87	1.58	2.47	3.54	5.35	7.18	9.07	12.38	15.00
3 100	0.86	1.56	2.43	3.48	5.27	7.07	8.92	12.18	15.00
3 150	0.84	1.53	2.39	3.43	5.18	6.96	8.78	11.98	15.00
3 200	0.83	1.51	2.36	3.37	5.10	6.85	8.64	11.79	15.00
3 250	0.82	1.48	2.32	3.32	5.02	6.74	8.51	11.61	15.00
3 300	0.81	1.46	2.28	3.27	4.95	6.64	8.38	11.44	15.00
3 350	0.79	1.44	2.25	3.22	4.87	6.54	8.25	11.27	15.00
3 400	0.78	1.42	2.22	3.17	4.80	6.44	8.13	11.10	14.87
3 450	0.77	1.40	2.18	3.13	4.73	6.35	8.02	10.94	14.65
3 500	0.76	1.38	2.15	3.08	4.67	6.26	7.90	10.78	14.44
3 550	0.75	1.36	2.12	3.04	4.60	6.17	7.79	10.63	14.24
3 600	0.74	1.34	2.09	3.00	4.54	6.09	7.68	10.48	14.04
3 650	0.73	1.32	2.06	2.96	4.47	6.00	7.58	10.34	13.85
3 700	0.72	1.30	2.04	2.92	4.41	5.92	7.47	10.20	13.66
3 750	0.71	1.29	2.01	2.88	4.35	5.84	7.37	10.07	13.48
3 800	0.70	1.27	1.98	2.84	4.30	5.77	7.28	9.93	13.30
3 850	0.69	1.25	1.96	2.80	4.24	5.69	7.18	9.80	13.13
3 900	0.68	1.24	1.93	2.77	4.19	5.62	7.09	9.68	12.96
3 950	0.67	1.22	1.91	2.73	4.13	5.55	7.00	9.56	12.80
4 000	0.67	1.21	1.88	2.70	4.08	5.48	6.91	9.44	12.64
4 050	0.66	1.19	1.86	2.66	4.03	5.41	6.83	9.32	12.48
4 100	0.65	1.18	1.84	2.63	3.98	5.34	6.74	9.21	12.33

Table 8 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 150	0.64	1.16	1.82	2.60	3.93	5.28	6.66	9.09	12.18
4 200	0.63	1.15	1.79	2.57	3.89	5.22	6.58	8.99	12.04
4 250	0.63	1.13	1.77	2.54	3.84	5.16	6.51	8.88	11.89
4 300	0.62	1.12	1.75	2.51	3.80	5.10	6.43	8.78	11.76
4 350	0.61	1.11	1.73	2.48	3.75	5.04	6.36	8.68	11.62
4 400	0.60	1.10	1.71	2.45	3.71	4.98	6.28	8.58	11.49
4 450	0.60	1.08	1.69	2.43	3.67	4.92	6.21	8.48	11.36
4 500	0.59	1.07	1.67	2.40	3.63	4.87	6.14	8.39	11.23
4 550	0.58	1.06	1.66	2.37	3.59	4.82	6.08	8.30	11.11
4 600	0.58	1.05	1.64	2.35	3.55	4.76	6.01	8.21	10.99
4 650	0.57	1.04	1.62	2.32	3.51	4.71	5.95	8.12	10.87
4 700	0.57	1.03	1.60	2.30	3.47	4.66	5.88	8.03	10.76
4 750	0.56	1.01	1.59	2.27	3.44	4.61	5.82	7.95	10.64
4 800	0.55	1.00	1.57	2.25	3.40	4.56	5.76	7.86	10.53
4 850	0.55	0.99	1.55	2.23	3.37	4.52	5.70	7.78	10.42
4 900	0.54	0.98	1.54	2.20	3.33	4.47	5.64	7.70	10.32
4 950	0.54	0.97	1.52	2.18	3.30	4.43	5.59	7.63	10.21
5 000	0.53	0.96	1.51	2.16	3.27	4.38	5.53	7.55	10.11
Maximum aspect ratio	7.3	6.8	6.5	6.3	5.9	4.9	4.3	3.8	3.3

Table 9 Maximum Areas for Insulating Glass Fixed on All Four Sides, m^2

(*Clause* 5.9)

Design Wind Pressure N/m^2	**Nominal Thickness of Glass, *T*** mm						
	3 + 3	4 + 4	5 + 5	6 + 6	8 + 8	10 + 10	12 + 12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
500	3.19	5.78	9.04	12.95	15.00	15.00	15.00
550	2.90	5.26	8.22	11.77	15.00	15.00	15.00
600	2.66	4.82	7.54	10.79	15.00	15.00	15.00
650	2.46	4.45	6.96	9.96	15.00	15.00	15.00
700	2.28	4.13	6.46	9.25	14.00	15.00	15.00
750	2.13	3.86	6.03	8.63	13.06	15.00	15.00
800	2.00	3.62	5.65	8.09	12.25	15.00	15.00
850	1.88	3.40	5.32	7.62	11.53	15.00	15.00
900	1.77	3.21	5.02	7.19	10.89	14.61	15.00
950	1.68	3.04	4.76	6.82	10.31	13.84	15.00
1 000	1.60	2.89	4.52	6.48	9.80	13.15	15.00
1 050	1.52	2.75	4.31	6.17	9.33	12.52	15.00
1 100	1.45	2.63	4.11	5.89	8.91	11.95	15.00
1 150	1.39	2.52	3.93	5.63	8.52	11.43	14.43
1 200	1.33	2.41	3.77	5.40	8.16	10.96	13.83
1 250	1.28	2.31	3.62	5.18	7.84	10.52	13.27
1 300	1.23	2.22	3.48	4.98	7.54	10.11	12.76
1 350	1.18	2.14	3.35	4.80	7.26	9.74	12.29
1 400	1.14	2.07	3.23	4.63	7.00	9.39	11.85
1 450	1.10	1.99	3.12	4.47	6.76	9.07	11.44
1 500	1.06	1.93	3.01	4.32	6.53	8.76	11.06
1 550	1.03	1.87	2.92	4.18	6.32	8.48	10.70
1 600	1.00	1.81	2.83	4.05	6.12	8.22	10.37
1 650	0.97	1.75	2.74	3.92	5.94	7.97	10.06
1 700	0.94	1.70	2.66	3.81	5.76	7.73	9.76
1 750	0.91	1.65	2.58	3.70	5.60	7.51	9.48
1 800	0.89	1.61	2.51	3.60	5.44	7.30	9.22
1 850	0.86	1.56	2.44	3.50	5.30	7.11	8.97
1 900	0.84	1.52	2.38	3.41	5.16	6.92	8.73
1 950	0.82	1.48	2.32	3.32	5.02	6.74	8.51
2 000	0.80	1.45	2.26	3.24	4.90	6.57	8.30
2 050	0.78	1.41	2.21	3.16	4.78	6.41	8.09
2 100	0.76	1.38	2.15	3.08	4.67	6.26	7.90
2 150	0.74	1.35	2.10	3.01	4.56	6.11	7.72
2 200	0.73	1.31	2.06	2.94	4.45	5.98	7.54
2 250	0.71	1.29	2.01	2.88	4.35	5.84	7.37

Table 9 (*Continued*)

Design Wind Pressure N/m^2	**Nominal Thickness of Glass, *T*** mm						
	3 + 3	4 + 4	5 + 5	6 + 6	8 + 8	10 + 10	12 + 12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2 300	0.69	1.26	1.97	2.82	4.26	5.72	7.21
2 350	0.68	1.23	1.92	2.76	4.17	5.59	7.06
2 400	0.67	1.21	1.88	2.70	4.08	5.48	6.91
2 450	0.65	1.18	1.85	2.64	4.00	5.37	6.77
2 500	0.64	1.16	1.81	2.59	3.92	5.26	6.64
2 550	0.63	1.13	1.77	2.54	3.84	5.16	6.51
2 600	0.61	1.11	1.74	2.49	3.77	5.06	6.38
2 650	0.60	1.09	1.71	2.44	3.70	4.96	6.26
2 700	0.59	1.07	1.67	2.40	3.63	4.87	6.14
2 750	0.58	1.05	1.64	2.35	3.56	4.78	6.03
2 800	0.57	1.03	1.61	2.31	3.50	4.70	5.93
2 850	0.56	1.01	1.59	2.27	3.44	4.61	5.82
2 900	0.55	1.00	1.56	2.23	3.38	4.53	5.72
2 950	0.54	0.98	1.53	2.19	3.32	4.46	5.62
3 000	0.53	0.96	1.51	2.16	3.27	4.38	5.53
3 050	0.52	0.95	1.48	2.12	3.21	4.31	5.44
3 100	0.51	0.93	1.46	2.09	3.16	4.24	5.35
3 150	0.51	0.92	1.44	2.06	3.11	4.17	5.27
3 200	0.50	0.90	1.41	2.02	3.06	4.11	5.18
3 250	0.49	0.89	1.39	1.99	3.01	4.05	5.11
3 300	0.48	0.88	1.37	1.96	2.97	3.98	5.03
3 350	0.48	0.86	1.35	1.93	2.92	3.92	4.95
3 400	0.47	0.85	1.33	1.90	2.88	3.87	4.88
3 450	0.46	0.84	1.31	1.88	2.84	3.81	4.81
3 500	0.46	0.83	1.29	1.85	2.80	3.76	4.74
3 550	0.45	0.81	1.27	1.82	2.76	3.70	4.67
3 600	0.44	0.80	1.26	1.80	2.72	3.65	4.61
3 650	0.44	0.79	1.24	1.77	2.68	3.60	4.55
3 700	0.43	0.78	1.22	1.75	2.65	3.55	4.48
3 750	0.43	0.77	1.21	1.73	2.61	3.51	4.42
3 800	0.42	0.76	1.19	1.70	2.58	3.46	4.37
3 850	0.41	0.75	1.17	1.68	2.54	3.41	4.31
3 900	0.41	0.74	1.16	1.66	2.51	3.37	4.25
3 950	0.40	0.73	1.14	1.64	2.48	3.33	4.20
4 000	0.40	0.72	1.13	1.62	2.45	3.29	4.15
4 050	0.39	0.71	1.12	1.60	2.42	3.25	4.10
4 100	0.39	0.71	1.10	1.58	2.39	3.21	4.05

Table 9 (*Concluded*)

Design Wind Pressure N/m² (1)	**Nominal Thickness of Glass, *T*** mm 3 + 3 (2)	4 + 4 (3)	5 + 5 (4)	6 + 6 (5)	8 + 8 (6)	10 + 10 (7)	12 + 12 (8)
4 150	0.38	0.70	1.09	1.56	2.36	3.17	4.00
4 200	0.38	0.69	1.08	1.54	2.33	3.13	3.95
4 250	0.38	0.68	1.06	1.52	2.31	3.09	3.90
4 300	0.37	0.67	1.05	1.51	2.28	3.06	3.86
4 350	0.37	0.66	1.04	1.49	2.25	3.02	3.81
4 400	0.36	0.66	1.03	1.47	2.23	2.99	3.77
4 450	0.36	0.65	1.02	1.46	2.20	2.95	3.73
4 500	0.35	0.64	1.00	1.44	2.18	2.92	3.69
4 550	0.35	0.64	0.99	1.42	2.15	2.89	3.65
4 600	0.35	0.63	0.98	1.41	2.13	2.86	3.61
4 650	0.34	0.62	0.97	1.39	2.11	2.83	3.57
4 700	0.34	0.62	0.96	1.38	2.08	2.80	3.53
4 750	0.34	0.61	0.95	1.36	2.06	2.77	3.49
4 800	0.33	0.60	0.94	1.35	2.04	2.74	3.46
4 850	0.33	0.60	0.93	1.34	2.02	2.71	3.42
4 900	0.33	0.59	0.92	1.32	2.00	2.68	3.39
4 950	0.32	0.58	0.91	1.31	1.98	2.66	3.35
5 000	0.32	0.58	0.90	1.30	1.96	2.63	3.32
Maximum aspect ratio	7.3	6.8	6.5	6.3	5.9	4.9	4.3

Table 10 Maximum Area for Heat Strengthened Glass Fixed on Four Sides, m^2

(*Clause* 5.9)

Design Wind Pressure N/m^2	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	3.41	6.17	9.65	13.81	15.00	15.00	15.00	15.00	15.00
550	3.10	5.61	8.77	12.56	15.00	15.00	15.00	15.00	15.00
600	2.84	5.14	8.04	11.51	15.00	15.00	15.00	15.00	15.00
650	2.62	4.75	7.42	10.63	15.00	15.00	15.00	15.00	15.00
700	2.43	4.41	6.89	9.87	14.93	15.00	15.00	15.00	15.00
750	2.27	4.11	6.43	9.21	13.93	15.00	15.00	15.00	15.00
800	2.13	3.86	6.03	8.63	13.06	15.00	15.00	15.00	15.00
850	2.00	3.63	5.67	8.13	12.29	15.00	15.00	15.00	15.00
900	1.89	3.43	5.36	7.67	11.61	15.00	15.00	15.00	15.00
950	1.79	3.25	5.08	7.27	11.00	14.76	15.00	15.00	15.00
1 000	1.70	3.09	4.82	6.91	10.45	14.02	15.00	15.00	15.00
1 050	1.62	2.94	4.59	6.58	9.95	13.36	15.00	15.00	15.00
1 100	1.55	2.80	4.38	6.28	9.50	12.75	15.00	15.00	15.00
1 150	1.48	2.68	4.19	6.01	9.09	12.19	15.00	15.00	15.00
1 200	1.42	2.57	4.02	5.76	8.71	11.69	14.75	15.00	15.00
1 250	1.36	2.47	3.86	5.53	8.36	11.22	14.16	15.00	15.00
1 300	1.31	2.37	3.71	5.31	8.04	10.79	13.61	15.00	15.00
1 350	1.26	2.29	3.57	5.12	7.74	10.39	13.11	15.00	15.00
1 400	1.22	2.20	3.45	4.93	7.46	10.02	12.64	15.00	15.00
1 450	1.17	2.13	3.33	4.76	7.21	9.67	12.21	15.00	15.00
1 500	1.14	2.06	3.22	4.60	6.97	9.35	11.80	15.00	15.00
1 550	1.10	1.99	3.11	4.46	6.74	9.05	11.42	15.00	15.00
1 600	1.06	1.93	3.01	4.32	6.53	8.76	11.06	15.00	15.00
1 650	1.03	1.87	2.92	4.19	6.33	8.50	10.73	14.64	15.00
1 700	1.00	1.81	2.84	4.06	6.15	8.25	10.41	14.21	15.00
1 750	0.97	1.76	2.76	3.95	5.97	8.01	10.11	13.80	15.00
1 800	0.95	1.71	2.68	3.84	5.81	7.79	9.83	13.42	15.00
1 850	0.92	1.67	2.61	3.73	5.65	7.58	9.57	13.06	15.00
1 900	0.90	1.62	2.54	3.64	5.50	7.38	9.31	12.71	15.00
1 950	0.87	1.58	2.47	3.54	5.36	7.19	9.08	12.39	15.00
2 000	0.85	1.54	2.41	3.45	5.23	7.01	8.85	12.08	15.00
2 050	0.83	1.50	2.35	3.37	5.10	6.84	8.63	11.78	15.00
2 100	0.81	1.47	2.30	3.29	4.98	6.68	8.43	11.50	15.00
2 150	0.79	1.43	2.24	3.21	4.86	6.52	8.23	11.24	15.00
2 200	0.77	1.40	2.19	3.14	4.75	6.37	8.04	10.98	14.71
2 250	0.76	1.37	2.14	3.07	4.64	6.23	7.87	10.74	14.38

Table 10 (*Continued*)

Design Wind Pressure N/m²	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 300	0.74	1.34	2.10	3.00	4.54	6.10	7.69	10.50	14.07
2 350	0.72	1.31	2.05	2.94	4.45	5.97	7.53	10.28	13.77
2 400	0.71	1.29	2.01	2.88	4.35	5.84	7.37	10.07	13.48
2 450	0.69	1.26	1.97	2.82	4.27	5.72	7.22	9.86	13.21
2 500	0.68	1.23	1.93	2.76	4.18	5.61	7.08	9.66	12.94
2 550	0.67	1.21	1.89	2.71	4.10	5.50	6.94	9.47	12.69
2 600	0.65	1.19	1.86	2.66	4.02	5.39	6.81	9.29	12.44
2 650	0.64	1.16	1.82	2.61	3.94	5.29	6.68	9.12	12.21
2 700	0.63	1.14	1.79	2.56	3.87	5.19	6.55	8.95	11.98
2 750	0.62	1.12	1.75	2.51	3.80	5.10	6.44	8.78	11.76
2 800	0.61	1.10	1.72	2.47	3.73	5.01	6.32	8.63	11.55
2 850	0.60	1.08	1.69	2.42	3.67	4.92	6.21	8.48	11.35
2 900	0.59	1.06	1.66	2.38	3.60	4.84	6.10	8.33	11.16
2 950	0.58	1.05	1.63	2.34	3.54	4.75	6.00	8.19	10.97
3 000	0.57	1.03	1.61	2.30	3.48	4.67	5.90	8.05	10.78
3 050	0.56	1.01	1.58	2.26	3.43	4.60	5.80	7.92	10.61
3 100	0.55	1.00	1.56	2.23	3.37	4.52	5.71	7.79	10.44
3 150	0.54	0.98	1.53	2.19	3.32	4.45	5.62	7.67	10.27
3 200	0.53	0.96	1.51	2.16	3.27	4.38	5.53	7.55	10.11
3 250	0.52	0.95	1.48	2.13	3.22	4.31	5.45	7.43	9.95
3 300	0.52	0.93	1.46	2.09	3.17	4.25	5.36	7.32	9.80
3 350	0.51	0.92	1.44	2.06	3.12	4.19	5.28	7.21	9.66
3 400	0.50	0.91	1.42	2.03	3.07	4.12	5.21	7.10	9.52
3 450	0.49	0.89	1.40	2.00	3.03	4.06	5.13	7.00	9.38
3 500	0.49	0.88	1.38	1.97	2.99	4.01	5.06	6.90	9.24
3 550	0.48	0.87	1.36	1.95	2.94	3.95	4.99	6.80	9.11
3 600	0.47	0.86	1.34	1.92	2.90	3.90	4.92	6.71	8.99
3 650	0.47	0.85	1.32	1.89	2.86	3.84	4.85	6.62	8.86
3 700	0.46	0.83	1.30	1.87	2.82	3.79	4.78	6.53	8.74
3 750	0.45	0.82	1.29	1.84	2.79	3.74	4.72	6.44	8.63
3 800	0.45	0.81	1.27	1.82	2.75	3.69	4.66	6.36	8.51
3 850	0.44	0.80	1.25	1.79	2.71	3.64	4.60	6.27	8.40
3 900	0.44	0.79	1.24	1.77	2.68	3.60	4.54	6.19	8.30
3 950	0.43	0.78	1.22	1.75	2.65	3.55	4.48	6.12	8.19
4 000	0.43	0.77	1.21	1.73	2.61	3.51	4.42	6.04	8.09
4 050	0.42	0.76	1.19	1.71	2.58	3.46	4.37	5.96	7.99
4 100	0.42	0.75	1.18	1.68	2.55	3.42	4.32	5.89	7.89

Table 10 (*Concluded*)

Design Wind Pressure N/m²	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 150	0.41	0.74	1.16	1.66	2.52	3.38	4.26	5.82	7.80
4 200	0.41	0.73	1.15	1.64	2.49	3.34	4.21	5.75	7.70
4 250	0.40	0.73	1.13	1.63	2.46	3.30	4.16	5.68	7.61
4 300	0.40	0.72	1.12	1.61	2.43	3.26	4.12	5.62	7.52
4 350	0.39	0.71	1.11	1.59	2.40	3.22	4.07	5.55	7.44
4 400	0.39	0.70	1.10	1.57	2.38	3.19	4.02	5.49	7.35
4 450	0.38	0.69	1.08	1.55	2.35	3.15	3.98	5.43	7.27
4 500	0.38	0.69	1.07	1.53	2.32	3.12	3.93	5.37	7.19
4 550	0.37	0.68	1.06	1.52	2.30	3.08	3.89	5.31	7.11
4 600	0.37	0.67	1.05	1.50	2.27	3.05	3.85	5.25	7.03
4 650	0.37	0.66	1.04	1.49	2.25	3.02	3.81	5.19	6.96
4 700	0.36	0.66	1.03	1.47	2.22	2.98	3.77	5.14	6.88
4 750	0.36	0.65	1.02	1.45	2.20	2.95	3.73	5.09	6.81
4 800	0.35	0.64	1.00	1.44	2.18	2.92	3.69	5.03	6.74
4 850	0.35	0.64	0.99	1.42	2.15	2.89	3.65	4.98	6.67
4 900	0.35	0.63	0.98	1.41	2.13	2.86	3.61	4.93	6.60
4 950	0.34	0.62	0.97	1.40	2.11	2.83	3.58	4.88	6.54
5 000	0.34	0.62	0.96	1.38	2.09	2.80	3.54	4.83	6.47
Maximum aspect ratio	7.3	6.8	6.5	6.3	5.9	4.9	4.3	3.8	3.3

Table 11 Maximum Span for Annealed Glass Fixed on Two Opposite Sides, m

(*Clause* 5.9)

Design Wind Pressure N/m²	**Nominal Thickness of Annealed Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	0.53	0.73	0.92	1.12	1.40	1.77	2.11	2.68	3.36
550	0.51	0.69	0.88	1.07	1.33	1.69	2.02	2.56	3.20
600	0.48	0.66	0.84	1.02	1.27	1.62	1.93	2.45	3.07
650	0.46	0.64	0.81	0.98	1.22	1.56	1.85	2.35	2.95
700	0.45	0.61	0.78	0.95	1.18	1.50	1.79	2.26	2.84
750	0.43	0.59	0.75	0.91	1.14	1.45	1.73	2.19	2.74
800	0.42	0.57	0.73	0.88	1.10	1.40	1.67	2.12	2.66
850	0.41	0.56	0.71	0.86	1.07	1.36	1.62	2.06	2.58
900	0.40	0.54	0.69	0.83	1.04	1.32	1.58	2.00	2.50
950	0.38	0.53	0.67	0.81	1.01	1.29	1.53	1.94	2.44
1 000	0.37	0.51	0.65	0.79	0.99	1.25	1.49	1.89	2.38
1 050	0.37	0.50	0.64	0.77	0.96	1.22	1.46	1.85	2.32
1 100	0.36	0.49	0.62	0.75	0.94	1.20	1.43	1.81	2.26
1 150	0.35	0.48	0.61	0.74	0.92	1.17	1.39	1.77	2.22
1 200	0.34	0.47	0.60	0.72	0.90	1.15	1.36	1.73	2.17
1 250	0.34	0.46	0.58	0.71	0.88	1.12	1.34	1.69	2.12
1 300	0.33	0.45	0.57	0.69	0.87	1.10	1.31	1.66	2.08
1 350	0.32	0.44	0.56	0.68	0.85	1.08	1.29	1.63	2.04
1 400	0.32	0.43	0.55	0.67	0.83	1.06	1.26	1.60	2.01
1 450	0.31	0.43	0.54	0.66	0.82	1.04	1.24	1.57	1.97
1 500	0.31	0.42	0.53	0.65	0.81	1.02	1.22	1.55	1.94
1 550	0.30	0.41	0.52	0.64	0.79	1.01	1.20	1.52	1.91
1 600	0.30	0.41	0.52	0.63	0.78	0.99	1.18	1.50	1.88
1 650	0.29	0.40	0.51	0.62	0.77	0.98	1.16	1.48	1.85
1 700	0.29	0.39	0.50	0.61	0.76	0.96	1.15	1.45	1.82
1 750	0.28	0.39	0.49	0.60	0.75	0.95	1.13	1.43	1.80
1 800	0.28	0.38	0.49	0.59	0.74	0.93	1.11	1.41	1.77
1 850	0.28	0.38	0.48	0.58	0.73	0.92	1.10	1.39	1.75
1 900	0.27	0.37	0.47	0.57	0.72	0.91	1.08	1.37	1.72
1 950	0.27	0.37	0.47	0.57	0.71	0.90	1.07	1.36	1.70
2 000	0.27	0.36	0.46	0.56	0.70	0.89	1.06	1.34	1.68
2 050	0.26	0.36	0.46	0.55	0.69	0.88	1.04	1.32	1.66
2 100	0.26	0.35	0.45	0.55	0.68	0.87	1.03	1.31	1.64
2 150	0.26	0.35	0.44	0.54	0.67	0.86	1.02	1.29	1.62
2 200	0.25	0.35	0.44	0.53	0.67	0.85	1.01	1.28	1.60
2 250	0.25	0.34	0.43	0.53	0.66	0.84	1.00	1.26	1.58

Table 11 (*Continued*)

Design Wind Pressure N/m^2	**Nominal Thickness of Annealed Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 300	0.25	0.34	0.43	0.52	0.65	0.83	0.99	1.25	1.57
2 350	0.24	0.34	0.43	0.52	0.64	0.82	0.97	1.24	1.55
2 400	0.24	0.33	0.42	0.51	0.64	0.81	0.96	1.22	1.53
2 450	0.24	0.33	0.42	0.51	0.63	0.80	0.95	1.21	1.52
2 500	0.24	0.32	0.41	0.50	0.62	0.79	0.95	1.20	1.50
2 550	0.23	0.32	0.41	0.50	0.62	0.79	0.94	1.19	1.49
2 600	0.23	0.32	0.40	0.49	0.61	0.78	0.93	1.18	1.47
2 650	0.23	0.32	0.40	0.49	0.61	0.77	0.92	1.16	1.46
2 700	0.23	0.31	0.40	0.48	0.60	0.76	0.91	1.15	1.45
2 750	0.23	0.31	0.39	0.48	0.60	0.76	0.90	1.14	1.43
2 800	0.22	0.31	0.39	0.47	0.59	0.75	0.89	1.13	1.42
2 850	0.22	0.30	0.39	0.47	0.58	0.74	0.89	1.12	1.41
2 900	0.22	0.30	0.38	0.46	0.58	0.74	0.88	1.11	1.39
2 950	0.22	0.30	0.38	0.46	0.57	0.73	0.87	1.10	1.38
3 000	0.22	0.30	0.38	0.46	0.57	0.72	0.86	1.09	1.37
3 050	0.21	0.29	0.37	0.45	0.57	0.72	0.86	1.09	1.36
3 100	0.21	0.29	0.37	0.45	0.56	0.71	0.85	1.08	1.35
3 150	0.21	0.29	0.37	0.45	0.56	0.71	0.84	1.07	1.34
3 200	0.21	0.29	0.36	0.44	0.55	0.70	0.84	1.06	1.33
3 250	0.21	0.28	0.36	0.44	0.55	0.70	0.83	1.05	1.32
3 300	0.21	0.28	0.36	0.44	0.54	0.69	0.82	1.04	1.31
3 350	0.20	0.28	0.36	0.43	0.54	0.69	0.82	1.04	1.30
3 400	0.20	0.28	0.35	0.43	0.54	0.68	0.81	1.03	1.29
3 450	0.20	0.28	0.35	0.43	0.53	0.68	0.80	1.02	1.28
3 500	0.20	0.27	0.35	0.42	0.53	0.67	0.80	1.01	1.27
3 550	0.20	0.27	0.35	0.42	0.52	0.67	0.79	1.01	1.26
3 600	0.20	0.27	0.34	0.42	0.52	0.66	0.79	1.00	1.25
3 650	0.20	0.27	0.34	0.41	0.52	0.66	0.78	0.99	1.24
3 700	0.19	0.27	0.34	0.41	0.51	0.65	0.78	0.99	1.23
3 750	0.19	0.27	0.34	0.41	0.51	0.65	0.77	0.98	1.23
3 800	0.19	0.26	0.33	0.41	0.51	0.64	0.77	0.97	1.22
3 850	0.19	0.26	0.33	0.40	0.50	0.64	0.76	0.97	1.21
3 900	0.19	0.26	0.33	0.40	0.50	0.64	0.76	0.96	1.20
3 950	0.19	0.26	0.33	0.40	0.50	0.63	0.75	0.95	1.20
4 000	0.19	0.26	0.33	0.40	0.49	0.63	0.75	0.95	1.19
4 050	0.19	0.26	0.32	0.39	0.49	0.62	0.74	0.94	1.18

Table 11 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Annealed Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 100	0.19	0.25	0.32	0.39	0.49	0.62	0.74	0.94	1.17
4 150	0.18	0.25	0.32	0.39	0.48	0.62	0.73	0.93	1.17
4 200	0.18	0.25	0.32	0.39	0.48	0.61	0.73	0.92	1.16
4 250	0.18	0.25	0.32	0.38	0.48	0.61	0.72	0.92	1.15
4 300	0.18	0.25	0.31	0.38	0.48	0.60	0.72	0.91	1.15
4 350	0.18	0.25	0.31	0.38	0.47	0.60	0.72	0.91	1.14
4 400	0.18	0.24	0.31	0.38	0.47	0.60	0.71	0.90	1.13
4 450	0.18	0.24	0.31	0.38	0.47	0.59	0.71	0.90	1.13
4 500	0.18	0.24	0.31	0.37	0.47	0.59	0.70	0.89	1.12
4 550	0.18	0.24	0.31	0.37	0.46	0.59	0.70	0.89	1.11
4 600	0.17	0.24	0.30	0.37	0.46	0.58	0.70	0.88	1.11
4 650	0.17	0.24	0.30	0.37	0.46	0.58	0.69	0.88	1.10
4 700	0.17	0.24	0.30	0.36	0.46	0.58	0.69	0.87	1.10
4 750	0.17	0.24	0.30	0.36	0.45	0.58	0.69	0.87	1.09
4 800	0.17	0.23	0.30	0.36	0.45	0.57	0.68	0.86	1.08
4 850	0.17	0.23	0.30	0.36	0.45	0.57	0.68	0.86	1.08
4 900	0.17	0.23	0.29	0.36	0.45	0.57	0.68	0.86	1.07
4 950	0.17	0.23	0.29	0.36	0.44	0.56	0.67	0.85	1.07
5 000	0.17	0.23	0.29	0.35	0.44	0.56	0.67	0.85	1.06

Table 12 Maximum Span for Laminated Glass Fixed on Two Opposite Sides, m

(*Clause* 5.9)

Design Wind Pressure N/m²	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
500	0.79	0.95	1.25	1.59	1.92	2.50
550	0.75	0.90	1.19	1.51	1.83	2.38
600	0.72	0.87	1.14	1.45	1.76	2.28
650	0.69	0.83	1.10	1.39	1.69	2.19
700	0.67	0.80	1.06	1.34	1.63	2.11
750	0.65	0.77	1.02	1.30	1.57	2.04
800	0.62	0.75	0.99	1.25	1.52	1.98
850	0.61	0.73	0.96	1.22	1.48	1.92
900	0.59	0.71	0.93	1.18	1.43	1.86
950	0.57	0.69	0.91	1.15	1.40	1.81
1 000	0.56	0.67	0.88	1.12	1.36	1.77
1 050	0.55	0.65	0.86	1.09	1.33	1.72
1 100	0.53	0.64	0.84	1.07	1.30	1.68
1 150	0.52	0.63	0.82	1.05	1.27	1.65
1 200	0.51	0.61	0.81	1.02	1.24	1.61
1 250	0.50	0.60	0.79	1.00	1.22	1.58
1 300	0.49	0.59	0.77	0.98	1.19	1.55
1 350	0.48	0.58	0.76	0.97	1.17	1.52
1 400	0.47	0.57	0.75	0.95	1.15	1.49
1 450	0.46	0.56	0.73	0.93	1.13	1.47
1 500	0.46	0.55	0.72	0.92	1.11	1.44
1 550	0.45	0.54	0.71	0.90	1.09	1.42
1 600	0.44	0.53	0.70	0.89	1.08	1.40
1 650	0.43	0.52	0.69	0.87	1.06	1.38
1 700	0.43	0.51	0.68	0.86	1.04	1.35
1 750	0.42	0.51	0.67	0.85	1.03	1.34
1 800	0.42	0.50	0.66	0.84	1.01	1.32
1 850	0.41	0.49	0.65	0.82	1.00	1.30
1 900	0.41	0.49	0.64	0.81	0.99	1.28
1 950	0.40	0.48	0.63	0.80	0.97	1.27
2 000	0.40	0.47	0.62	0.79	0.96	1.25
2 050	0.39	0.47	0.62	0.78	0.95	1.23
2 100	0.39	0.46	0.61	0.77	0.94	1.22
2 150	0.38	0.46	0.60	0.77	0.93	1.20
2 200	0.38	0.45	0.60	0.76	0.92	1.19
2 250	0.37	0.45	0.59	0.75	0.91	1.18

Table 12 (*Continued*)

Design Wind Pressure N/m²	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2 300	0.37	0.44	0.58	0.74	0.90	1.16
2 350	0.36	0.44	0.58	0.73	0.89	1.15
2 400	0.36	0.43	0.57	0.72	0.88	1.14
2 450	0.36	0.43	0.56	0.72	0.87	1.13
2 500	0.35	0.42	0.56	0.71	0.86	1.12
2 550	0.35	0.42	0.55	0.70	0.85	1.11
2 600	0.35	0.42	0.55	0.70	0.84	1.10
2 650	0.34	0.41	0.54	0.69	0.84	1.09
2 700	0.34	0.41	0.54	0.68	0.83	1.08
2 750	0.34	0.40	0.53	0.68	0.82	1.07
2 800	0.33	0.40	0.53	0.67	0.81	1.06
2 850	0.33	0.40	0.52	0.66	0.81	1.05
2 900	0.33	0.39	0.52	0.66	0.80	1.04
2 950	0.33	0.39	0.51	0.65	0.79	1.03
3 000	0.32	0.39	0.51	0.65	0.79	1.02
3 050	0.32	0.38	0.51	0.64	0.78	1.01
3 100	0.32	0.38	0.50	0.64	0.77	1.00
3 150	0.31	0.38	0.50	0.63	0.77	1.00
3 200	0.31	0.37	0.49	0.63	0.76	0.99
3 250	0.31	0.37	0.49	0.62	0.75	0.98
3 300	0.31	0.37	0.49	0.62	0.75	0.97
3 350	0.31	0.37	0.48	0.61	0.74	0.97
3 400	0.30	0.36	0.48	0.61	0.74	0.96
3 450	0.30	0.36	0.48	0.60	0.73	0.95
3 500	0.30	0.36	0.47	0.60	0.73	0.94
3 550	0.30	0.36	0.47	0.60	0.72	0.94
3 600	0.29	0.35	0.47	0.59	0.72	0.93
3 650	0.29	0.35	0.46	0.59	0.71	0.92
3 700	0.29	0.35	0.46	0.58	0.71	0.92
3 750	0.29	0.35	0.46	0.58	0.70	0.91
3 800	0.29	0.34	0.45	0.58	0.70	0.91
3 850	0.28	0.34	0.45	0.57	0.69	0.90
3 900	0.28	0.34	0.45	0.57	0.69	0.89
3 950	0.28	0.34	0.44	0.56	0.68	0.89
4 000	0.28	0.34	0.44	0.56	0.68	0.88
4 050	0.28	0.33	0.44	0.56	0.68	0.88
4 100	0.28	0.33	0.44	0.55	0.67	0.87

Table 12 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Laminated Glass, *T*** mm					
	5.38	6.38	8.38	10.38	12.38	16.38
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4 150	0.27	0.33	0.43	0.55	0.67	0.87
4 200	0.27	0.33	0.43	0.55	0.66	0.86
4 250	0.27	0.33	0.43	0.54	0.66	0.86
4 300	0.27	0.32	0.43	0.54	0.66	0.85
4 350	0.27	0.32	0.42	0.54	0.65	0.85
4 400	0.27	0.32	0.42	0.53	0.65	0.84
4 450	0.26	0.32	0.42	0.53	0.65	0.84
4 500	0.26	0.32	0.42	0.53	0.64	0.83
4 550	0.26	0.31	0.41	0.53	0.64	0.83
4 600	0.26	0.31	0.41	0.52	0.63	0.82
4 650	0.26	0.31	0.41	0.52	0.63	0.82
4 700	0.26	0.31	0.41	0.52	0.63	0.81
4 750	0.26	0.31	0.41	0.51	0.62	0.81
4 800	0.26	0.31	0.40	0.51	0.62	0.81
4 850	0.25	0.30	0.40	0.51	0.62	0.80
4 900	0.25	0.30	0.40	0.51	0.61	0.80
4 950	0.25	0.30	0.40	0.50	0.61	0.79
5 000	0.25	0.30	0.40	0.50	0.61	0.79

Table 13 Maximum Span for Tempered Glass Fixed on Two Opposite Sides, m

(*Clause* 5.9)

Design Wind Pressure N/m²	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	0.62	0.86	1.09	1.32	1.52	1.93	2.30	2.92	3.66
550	0.60	0.82	1.04	1.26	1.45	1.84	2.20	2.78	3.49
600	0.57	0.78	0.99	1.20	1.39	1.76	2.10	2.66	3.34
650	0.55	0.75	0.95	1.16	1.33	1.69	2.02	2.56	3.21
700	0.53	0.72	0.92	1.11	1.29	1.63	1.95	2.47	3.09
750	0.51	0.70	0.89	1.08	1.24	1.58	1.88	2.38	2.99
800	0.49	0.68	0.86	1.04	1.20	1.53	1.82	2.31	2.89
850	0.48	0.66	0.83	1.01	1.17	1.48	1.77	2.24	2.81
900	0.47	0.64	0.81	0.98	1.13	1.44	1.72	2.18	2.73
950	0.45	0.62	0.79	0.96	1.10	1.40	1.67	2.12	2.65
1 000	0.44	0.60	0.77	0.93	1.08	1.37	1.63	2.06	2.59
1 050	0.43	0.59	0.75	0.91	1.05	1.33	1.59	2.01	2.52
1 100	0.42	0.58	0.73	0.89	1.03	1.30	1.55	1.97	2.47
1 150	0.41	0.56	0.72	0.87	1.00	1.27	1.52	1.92	2.41
1 200	0.40	0.55	0.70	0.85	0.98	1.25	1.49	1.88	2.36
1 250	0.39	0.54	0.69	0.83	0.96	1.22	1.46	1.85	2.31
1 300	0.39	0.53	0.67	0.82	0.94	1.20	1.43	1.81	2.27
1 350	0.38	0.52	0.66	0.80	0.93	1.18	1.40	1.78	2.23
1 400	0.37	0.51	0.65	0.79	0.91	1.15	1.38	1.74	2.19
1 450	0.37	0.50	0.64	0.77	0.89	1.13	1.35	1.71	2.15
1 500	0.36	0.49	0.63	0.76	0.88	1.12	1.33	1.69	2.11
1 550	0.35	0.49	0.62	0.75	0.86	1.10	1.31	1.66	2.08
1 600	0.35	0.48	0.61	0.74	0.85	1.08	1.29	1.63	2.05
1 650	0.34	0.47	0.60	0.73	0.84	1.06	1.27	1.61	2.01
1 700	0.34	0.46	0.59	0.71	0.82	1.05	1.25	1.58	1.98
1 750	0.33	0.46	0.58	0.70	0.81	1.03	1.23	1.56	1.96
1 800	0.33	0.45	0.57	0.69	0.80	1.02	1.21	1.54	1.93
1 850	0.32	0.44	0.56	0.68	0.79	1.00	1.20	1.52	1.90
1 900	0.32	0.44	0.56	0.68	0.78	0.99	1.18	1.50	1.88
1 950	0.32	0.43	0.55	0.67	0.77	0.98	1.17	1.48	1.85
2 000	0.31	0.43	0.54	0.66	0.76	0.97	1.15	1.46	1.83
2 050	0.31	0.42	0.54	0.65	0.75	0.95	1.14	1.44	1.81
2 100	0.30	0.42	0.53	0.64	0.74	0.94	1.12	1.42	1.79
2 150	0.30	0.41	0.52	0.64	0.73	0.93	1.11	1.41	1.76
2 200	0.30	0.41	0.52	0.63	0.73	0.92	1.10	1.39	1.74
2 250	0.29	0.40	0.51	0.62	0.72	0.91	1.09	1.38	1.72

Table 13 (*Continued*)

Design Wind Pressure N/m²	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 300	0.29	0.40	0.51	0.61	0.71	0.90	1.07	1.36	1.71
2 350	0.29	0.39	0.50	0.61	0.70	0.89	1.06	1.35	1.69
2 400	0.28	0.39	0.50	0.60	0.69	0.88	1.05	1.33	1.67
2 450	0.28	0.39	0.49	0.60	0.69	0.87	1.04	1.32	1.65
2 500	0.28	0.38	0.49	0.59	0.68	0.86	1.03	1.31	1.64
2 550	0.28	0.38	0.48	0.58	0.67	0.86	1.02	1.29	1.62
2 600	0.27	0.38	0.48	0.58	0.67	0.85	1.01	1.28	1.60
2 650	0.27	0.37	0.47	0.57	0.66	0.84	1.00	1.27	1.59
2 700	0.27	0.37	0.47	0.57	0.65	0.83	0.99	1.26	1.57
2 750	0.27	0.36	0.46	0.56	0.65	0.82	0.98	1.24	1.56
2 800	0.26	0.36	0.46	0.56	0.64	0.82	0.97	1.23	1.55
2 850	0.26	0.36	0.46	0.55	0.64	0.81	0.96	1.22	1.53
2 900	0.26	0.36	0.45	0.55	0.63	0.80	0.96	1.21	1.52
2 950	0.26	0.35	0.45	0.54	0.63	0.80	0.95	1.20	1.51
3 000	0.25	0.35	0.44	0.54	0.62	0.79	0.94	1.19	1.49
3 050	0.25	0.35	0.44	0.53	0.62	0.78	0.93	1.18	1.48
3 100	0.25	0.34	0.44	0.53	0.61	0.78	0.92	1.17	1.47
3 150	0.25	0.34	0.43	0.52	0.61	0.77	0.92	1.16	1.46
3 200	0.25	0.34	0.43	0.52	0.60	0.76	0.91	1.15	1.45
3 250	0.24	0.34	0.43	0.52	0.60	0.76	0.90	1.14	1.44
3 300	0.24	0.33	0.42	0.51	0.59	0.75	0.90	1.14	1.42
3 350	0.24	0.33	0.42	0.51	0.59	0.75	0.89	1.13	1.41
3 400	0.24	0.33	0.42	0.51	0.58	0.74	0.88	1.12	1.40
3 450	0.24	0.33	0.41	0.50	0.58	0.74	0.88	1.11	1.39
3 500	0.24	0.32	0.41	0.50	0.57	0.73	0.87	1.10	1.38
3 550	0.23	0.32	0.41	0.49	0.57	0.73	0.86	1.10	1.37
3 600	0.23	0.32	0.40	0.49	0.57	0.72	0.86	1.09	1.36
3 650	0.23	0.32	0.40	0.49	0.56	0.72	0.85	1.08	1.35
3 700	0.23	0.31	0.40	0.48	0.56	0.71	0.85	1.07	1.34
3 750	0.23	0.31	0.40	0.48	0.56	0.71	0.84	1.07	1.34
3 800	0.23	0.31	0.39	0.48	0.55	0.70	0.84	1.06	1.33
3 850	0.22	0.31	0.39	0.47	0.55	0.70	0.83	1.05	1.32
3 900	0.22	0.31	0.39	0.47	0.54	0.69	0.82	1.05	1.31
3 950	0.22	0.30	0.39	0.47	0.54	0.69	0.82	1.04	1.30
4 000	0.22	0.30	0.38	0.47	0.54	0.68	0.81	1.03	1.29
4 050	0.22	0.30	0.38	0.46	0.53	0.68	0.81	1.03	1.29
4 100	0.22	0.30	0.38	0.46	0.53	0.67	0.80	1.02	1.28

Table 13 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Tempered Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 150	0.22	0.30	0.38	0.46	0.53	0.67	0.80	1.01	1.27
4 200	0.22	0.30	0.37	0.45	0.52	0.67	0.79	1.01	1.26
4 250	0.21	0.29	0.37	0.45	0.52	0.66	0.79	1.00	1.25
4 300	0.21	0.29	0.37	0.45	0.52	0.66	0.79	1.00	1.25
4 350	0.21	0.29	0.37	0.45	0.52	0.66	0.78	0.99	1.24
4 400	0.21	0.29	0.37	0.44	0.51	0.65	0.78	0.98	1.23
4 450	0.21	0.29	0.36	0.44	0.51	0.65	0.77	0.98	1.23
4 500	0.21	0.29	0.36	0.44	0.51	0.64	0.77	0.97	1.22
4 550	0.21	0.28	0.36	0.44	0.50	0.64	0.76	0.97	1.21
4 600	0.21	0.28	0.36	0.43	0.50	0.64	0.76	0.96	1.21
4 650	0.20	0.28	0.36	0.43	0.50	0.63	0.75	0.96	1.20
4 700	0.20	0.28	0.35	0.43	0.50	0.63	0.75	0.95	1.19
4 750	0.20	0.28	0.35	0.43	0.49	0.63	0.75	0.95	1.19
4 800	0.20	0.28	0.35	0.43	0.49	0.62	0.74	0.94	1.18
4 850	0.20	0.27	0.35	0.42	0.49	0.62	0.74	0.94	1.17
4 900	0.20	0.27	0.35	0.42	0.49	0.62	0.74	0.93	1.17
4 950	0.20	0.27	0.35	0.42	0.48	0.61	0.73	0.93	1.16
5 000	0.20	0.27	0.34	0.42	0.48	0.61	0.73	0.92	1.16

Table 14 Maximum Span for Heat Strengthened Glass Fixed on Two Opposite Sides, m

(*Clause* 5.9)

Design Wind Pressure N/m²	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
500	0.50	0.68	0.87	1.05	1.22	1.55	1.84	2.34	2.93
550	0.48	0.65	0.83	1.00	1.16	1.47	1.76	2.23	2.79
600	0.46	0.62	0.79	0.96	1.11	1.41	1.68	2.13	2.67
650	0.44	0.60	0.76	0.92	1.07	1.36	1.62	2.05	2.57
700	0.42	0.58	0.73	0.89	1.03	1.31	1.56	1.97	2.47
750	0.41	0.56	0.71	0.86	0.99	1.26	1.50	1.91	2.39
800	0.39	0.54	0.69	0.83	0.96	1.22	1.46	1.85	2.31
850	0.38	0.52	0.67	0.81	0.93	1.19	1.41	1.79	2.24
900	0.37	0.51	0.65	0.79	0.91	1.15	1.37	1.74	2.18
950	0.36	0.50	0.63	0.76	0.88	1.12	1.34	1.69	2.12
1 000	0.35	0.48	0.61	0.75	0.86	1.09	1.30	1.65	2.07
1 050	0.34	0.47	0.60	0.73	0.84	1.07	1.27	1.61	2.02
1 100	0.34	0.46	0.59	0.71	0.82	1.04	1.24	1.57	1.97
1 150	0.33	0.45	0.57	0.69	0.80	1.02	1.21	1.54	1.93
1 200	0.32	0.44	0.56	0.68	0.79	1.00	1.19	1.51	1.89
1 250	0.32	0.43	0.55	0.67	0.77	0.98	1.16	1.48	1.85
1 300	0.31	0.42	0.54	0.65	0.75	0.96	1.14	1.45	1.82
1 350	0.30	0.42	0.53	0.64	0.74	0.94	1.12	1.42	1.78
1 400	0.30	0.41	0.52	0.63	0.73	0.92	1.10	1.40	1.75
1 450	0.29	0.40	0.51	0.62	0.71	0.91	1.08	1.37	1.72
1 500	0.29	0.40	0.50	0.61	0.70	0.89	1.06	1.35	1.69
1 550	0.28	0.39	0.49	0.60	0.69	0.88	1.05	1.33	1.66
1 600	0.28	0.38	0.49	0.59	0.68	0.86	1.03	1.31	1.64
1 650	0.27	0.38	0.48	0.58	0.67	0.85	1.01	1.29	1.61
1 700	0.27	0.37	0.47	0.57	0.66	0.84	1.00	1.27	1.59
1 750	0.27	0.37	0.46	0.56	0.65	0.83	0.98	1.25	1.56
1 800	0.26	0.36	0.46	0.56	0.64	0.81	0.97	1.23	1.54
1 850	0.26	0.36	0.45	0.55	0.63	0.80	0.96	1.21	1.52
1 900	0.26	0.35	0.45	0.54	0.62	0.79	0.94	1.20	1.50
1 950	0.25	0.35	0.44	0.53	0.62	0.78	0.93	1.18	1.48
2 000	0.25	0.34	0.43	0.53	0.61	0.77	0.92	1.17	1.46
2 050	0.25	0.34	0.43	0.52	0.60	0.76	0.91	1.15	1.45
2 100	0.24	0.33	0.42	0.51	0.59	0.75	0.90	1.14	1.43
2 150	0.24	0.33	0.42	0.51	0.59	0.75	0.89	1.13	1.41
2 200	0.24	0.33	0.41	0.50	0.58	0.74	0.88	1.11	1.40
2 250	0.24	0.32	0.41	0.50	0.57	0.73	0.87	1.10	1.38

Table 14 (*Continued*)

Design Wind Pressure N/m²	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2 300	0.23	0.32	0.41	0.49	0.57	0.72	0.86	1.09	1.36
2 350	0.23	0.32	0.40	0.49	0.56	0.71	0.85	1.08	1.35
2 400	0.23	0.31	0.40	0.48	0.56	0.71	0.84	1.07	1.34
2 450	0.23	0.31	0.39	0.48	0.55	0.70	0.83	1.05	1.32
2 500	0.22	0.31	0.39	0.47	0.54	0.69	0.82	1.04	1.31
2 550	0.22	0.30	0.38	0.47	0.54	0.68	0.82	1.03	1.30
2 600	0.22	0.30	0.38	0.46	0.53	0.68	0.81	1.02	1.28
2 650	0.22	0.30	0.38	0.46	0.53	0.67	0.80	1.01	1.27
2 700	0.21	0.29	0.37	0.45	0.52	0.67	0.79	1.00	1.26
2 750	0.21	0.29	0.37	0.45	0.52	0.66	0.79	1.00	1.25
2 800	0.21	0.29	0.37	0.45	0.51	0.65	0.78	0.99	1.24
2 850	0.21	0.29	0.36	0.44	0.51	0.65	0.77	0.98	1.23
2 900	0.21	0.28	0.36	0.44	0.51	0.64	0.76	0.97	1.22
2 950	0.21	0.28	0.36	0.43	0.50	0.64	0.76	0.96	1.21
3 000	0.20	0.28	0.35	0.43	0.50	0.63	0.75	0.95	1.19
3 050	0.20	0.28	0.35	0.43	0.49	0.63	0.75	0.95	1.19
3 100	0.20	0.27	0.35	0.42	0.49	0.62	0.74	0.94	1.18
3 150	0.20	0.27	0.35	0.42	0.48	0.62	0.73	0.93	1.17
3 200	0.20	0.27	0.34	0.42	0.48	0.61	0.73	0.92	1.16
3 250	0.20	0.27	0.34	0.41	0.48	0.61	0.72	0.92	1.15
3 300	0.19	0.27	0.34	0.41	0.47	0.60	0.72	0.91	1.14
3 350	0.19	0.26	0.34	0.41	0.47	0.60	0.71	0.90	1.13
3 400	0.19	0.26	0.33	0.40	0.47	0.59	0.71	0.90	1.12
3 450	0.19	0.26	0.33	0.40	0.46	0.59	0.70	0.89	1.11
3 500	0.19	0.26	0.33	0.40	0.46	0.58	0.70	0.88	1.11
3 550	0.19	0.26	0.33	0.40	0.46	0.58	0.69	0.88	1.10
3 600	0.19	0.25	0.32	0.39	0.45	0.58	0.69	0.87	1.09
3 650	0.18	0.25	0.32	0.39	0.45	0.57	0.68	0.86	1.08
3 700	0.18	0.25	0.32	0.39	0.45	0.57	0.68	0.86	1.08
3 750	0.18	0.25	0.32	0.38	0.44	0.56	0.67	0.85	1.07
3 800	0.18	0.25	0.32	0.38	0.44	0.56	0.67	0.85	1.06
3 850	0.18	0.25	0.31	0.38	0.44	0.56	0.66	0.84	1.05
3 900	0.18	0.24	0.31	0.38	0.44	0.55	0.66	0.84	1.05
3 950	0.18	0.24	0.31	0.37	0.43	0.55	0.66	0.83	1.04
4 000	0.18	0.24	0.31	0.37	0.43	0.55	0.65	0.83	1.03
4 050	0.18	0.24	0.31	0.37	0.43	0.54	0.65	0.82	1.03
4 100	0.17	0.24	0.30	0.37	0.42	0.54	0.64	0.82	1.02

Table 14 (*Concluded*)

Design Wind Pressure N/m^2	**Nominal Thickness of Heat Strengthened Glass, *T*** mm								
	3	4	5	6	8	10	12	15	19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
4 150	0.17	0.24	0.30	0.37	0.42	0.54	0.64	0.81	1.02
4 200	0.17	0.24	0.30	0.36	0.42	0.53	0.64	0.81	1.01
4 250	0.17	0.23	0.30	0.36	0.42	0.53	0.63	0.80	1.00
4 300	0.17	0.23	0.30	0.36	0.41	0.53	0.63	0.80	1.00
4 350	0.17	0.23	0.29	0.36	0.41	0.52	0.62	0.79	0.99
4 400	0.17	0.23	0.29	0.36	0.41	0.52	0.62	0.79	0.99
4 450	0.17	0.23	0.29	0.35	0.41	0.52	0.62	0.78	0.98
4 500	0.17	0.23	0.29	0.35	0.41	0.52	0.61	0.78	0.98
4 550	0.17	0.23	0.29	0.35	0.40	0.51	0.61	0.77	0.97
4 600	0.16	0.23	0.29	0.35	0.40	0.51	0.61	0.77	0.97
4 650	0.16	0.22	0.28	0.35	0.40	0.51	0.60	0.77	0.96
4 700	0.16	0.22	0.28	0.34	0.40	0.50	0.60	0.76	0.95
4 750	0.16	0.22	0.28	0.34	0.39	0.50	0.60	0.76	0.95
4 800	0.16	0.22	0.28	0.34	0.39	0.50	0.59	0.75	0.94
4 850	0.16	0.22	0.28	0.34	0.39	0.50	0.59	0.75	0.94
4 900	0.16	0.22	0.28	0.34	0.39	0.49	0.59	0.75	0.94
4 950	0.16	0.22	0.28	0.33	0.39	0.49	0.59	0.74	0.93
5 000	0.16	0.22	0.27	0.33	0.38	0.49	0.58	0.74	0.93

6.5 Setting Blocks

The number and location of setting blocks shall be as shown in Figs. 1 and 3. Generally, setting blocks shall be:

a) Positioned at quarter points or not less than 30 mm from the corner, whichever is lesser;

b) Minimum width of each setting block shall be not less than the glass thickness; and

c) If a glazing bridge is used then the thickness of the glazing bridge can be added to the thickness of the setting block to achieve the minimum gap of 6 mm between the edge of glass and the framing member.

Setting blocks shall be located to equally support all panes of glass, and shall be fixed to prevent displacement during installation and service. The minimum length of each setting block (or two blocks side by side) shall be 25 mm in length for every square metre of glass area, with a minimum length of 50 mm. When wood is used as the material for setting blocks, only the seasoned ones should be used as green wood may shrink laterally (in the process of attaining equilibrium moisture content over a period of time) and result in loosened installations.

For example, for a 3.0 m^2 glass area, 3.0 × 25 mm = 75 mm long, that is, 75 mm is the length of each setting block.

Setting blocks shall be of resilient, load-bearing, non-absorbent, rot-proof, and material that is compatible with all other glazing materials conforming to available standards (if any) that may come into contact with the blocks.

NOTES

1 Setting blocks are used between the bottom edge of the unit and the frame to centralize and equally support both panes of glass.

2 Setting block width and location should not restrict water drainage.

3 Extruded rubber material with 80 to 90 shore A hardness is recommended.

4 Shaped setting blocks will be required for a glazing platform.

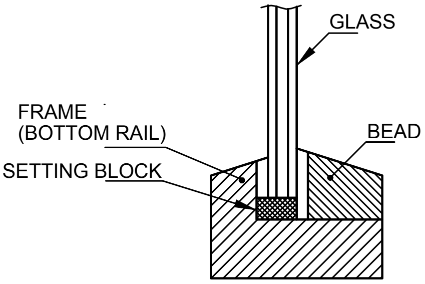


FIG. 1 POSITION OF SETTING BLOCK

6.6 Location Blocks

The number and position of location blocks shall be as shown in Figs. 2 and 3.

Location blocks shall be,

a) of minimum of 25 mm in length;
b) at least as wide as the glass thickness;
c) positively located to prevent displacement in service; and
d) sufficiently resilient to accommodate movement within the frame, without imposing stress on the glass, and of resilient, non-absorbent material.

NOTES

1 Location blocks are used between the edges of the glass and the frame to prevent movement of the glass within the frame by thermal expansion or when the window or door is opened or closed. They are required to prevent the weight of the glass from causing the frame to become out of square.

2 Extruded rubber material with 55 to 65 shore A hardness is recommended.

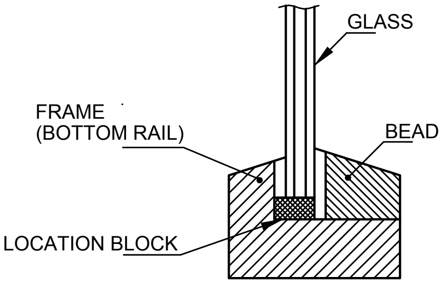


FIG. 2 POSITION OF LOCATION BLOCK

6.7 Distance Pieces

Distance pieces, as shown in Fig. 4, used where required, shall be,

a) of resilient, non-absorbent material;
b) 25 mm long and of a height to suit the depth of the rebate and the method of glazing; and
c) spaced opposite each other, approximately 50 mm from each corner at intervals of not more than 300 mm.

The thickness shall be equal to the front and back clearance, to retain the glass firmly in the frame.

NOTES

1 Distance pieces are required to prevent displacement of glazing compounds or sealant by external loading, such as wind pressure.

2 Extruded rubber material with 55 to 65 shore A hardness is required.

6.8 Rebates and Grooves for Installation

Rebates, grooves and beads shall be cleaned and free from grease, moisture and other contaminants. All sealant surfaces shall be primed or sealed in accordance with the recommendations of the manufacturer of the glazing material.

The number and location of setting blocks and location blocks shall be as shown in Figs. 1 to 3, wherever necessary to maintain the requisite edge clearance. Each block shall support the full thickness of the glass.

6.9 Glazing Beads

Where used, glazing beads shall be capable of restraining the glass under all design forces.

6.10 Structural Sealants

Structural silicone shall be installed such that a full adhesive bond to the substrate is achieved. Application of structural silicone may require prior cleaning and or priming of the substrate.

Applied structural silicones shall not be installed adjacent to other materials that may be chemically incompatible with the structural sealant and cause a loss of adhesion or adverse chemical changes within the structural silicone that could lead to a loss of strength in the structural silicone. For guidance on the installation of structural silicone, reference to available standards/ literatures may be made.

7 DESIGN CRITERIA

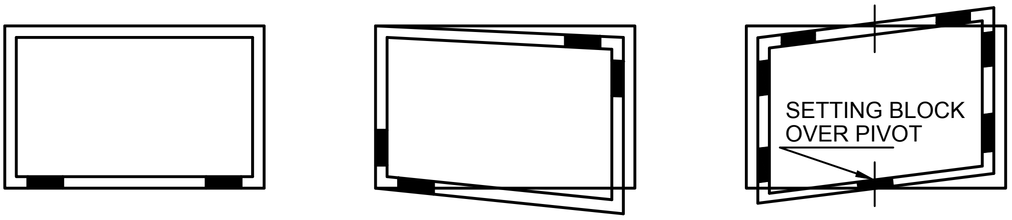
7.1 Frame Support Condition

7.1.1 *Maximum Area of Glass Panels Subjected to Wind Loading*

The maximum span for a given standard nominal thickness of ordinary annealed, laminated, heat-strengthened and toughened glass for a given panel size shall be determined in accordance with **7.2**, **7.3** and **7.4** as applicable for the relevant support conditions. For heat strengthened laminated and toughened laminated glass, maximum allowable span shall be determined in accordance with **7.5**. For 3 mm monolithic annealed glass, the maximum area shall not exceed 0.85 m^2.

The minimum thickness of the nominal glass size shall be as per relevant the Indian standards given in Annex A.

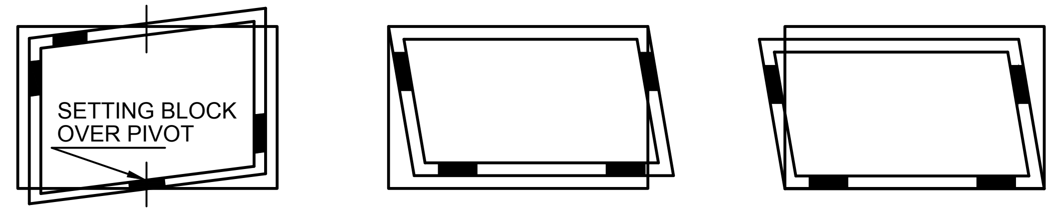
For laminated glass composites, the combined minimum thickness of the glass sheets may be used



(a) FIXED LIGHT

(b) SIDE HUNG, PROJECTED SIDE HUNG OR DOOR

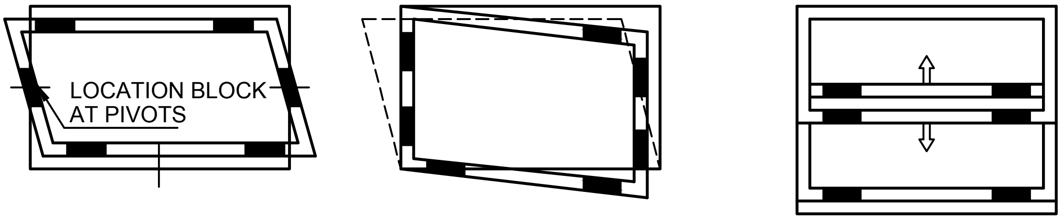
(c) VERTICALLY PIVOTED HUNG CENTRALLY



(d) VERTICALLY PIVOTED (HUNG OFF-CENTRE)

(e) TOP HUNG OR PROJECTED TOP HUNG

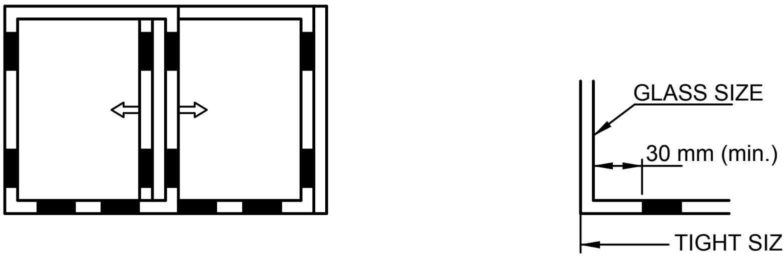
(f) BOTTOM HUNG



(g) HORIZONTALLY PIVOTED AND OPENING UPTO

(h) TILT AND TURN

(j) VERTICAL SLIDING



(k) HORIZONTAL SLIDING (6 BLOCK TO EACH PANE)

(m) MINIMUM POSITION OF BLOCKS FOR ALL TYPE OF CASEMENTS AND SLIDING WINDOWS

FIG. 3 RECOMMENDED POSITIONS OF SETTING AND LOCATION BLOCKS FOR THE SITE GLAZING OF SOME TYPES OF DOORS AND WINDOWS

excluding the interlayer thickness. Alternatively, reference to specialist literature may be drawn for the same purpose. Non-linear analysis may also be used for appropriate verification for various support condition.

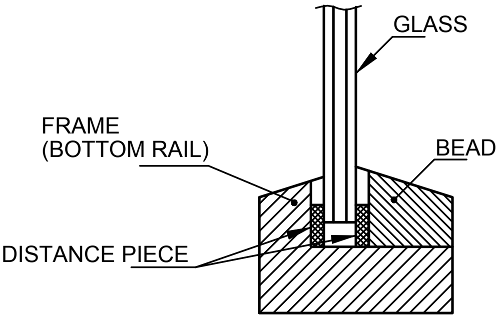


FIG. 4 POSITION OF DISTANCE PIECES

7.2 Rectangular Glass Supported on All Four Edges

For rectangular glass supported on all four edges, the maximum area for the design wind pressure shall be determined using the corresponding tables provided for each type of glass. Linear interpolation may be used for any value in between those given therein while maintaining the aspect ratio.

7.3 Rectangles of Glass Supported on Two Opposite Edges

For rectangles of glass supported on two opposite edges, the maximum glass area for the design wind pressure shall be determined from Tables 9 to 12 for ordinary annealed, laminated, heat-strengthened and toughened glass, respectively. *See also* Annex B.

7.4 Rectangles of Glass Supported on Three Edges

For rectangles of glass supported on three edges, the maximum glass area shall be determined as for two edge support spanning along the unsupported edge. Alternatively, basic engineering principles shall be adopted in determining the glass thickness for all applications where only three edges of the panel are supported.

NOTE — Butt glazing of adjacent panels in the same plane should not be considered as a support.

7.5 Heat-Strengthened Laminated and Toughened Laminated Glass

For heat-strengthened laminated and toughened laminated glass, the maximum span for a given standard nominal thickness for a given panel size shall be determined from Tables 10 and 14, and Tables 7 and 12, respectively with the design wind pressure being divided by the appropriate glass type factor, P_f (*see* Table 2), as applicable for the relevant support conditions.

7.6 Serviceability Checks

7.6.1 Glass complying with Tables 6 to 14 are deemed to meet, the serviceability deflection limits specified (in the absence of any other specified values) or the following values may be had for guidance.

7.6.2 *Maximum Allowable Deflection of Framing Members*

a) *For mullions*:
    1) Single height glazing — Span/175 or 19 mm, whichever is less.
    2) Double height glazing — For spans up to 4 110 mm, same as single height glazing; and for spans above 4 110 mm, the same shall be (Span/240) + 6.35 mm.
b) *For transoms*:
    1) Span/500 or 3 mm, whichever is the least for dead load.
    2) Span/175 or 19 mm, whichever is the least for wind load.
c) *Deflection at the centre of the glass*:
    1) Monolithic glass — Shortest span/60 or 19 mm, whichever is the least.
    2) Double glazed unit — Shortest span/90 or 19 mm, whichever is the least.
d) *Deflection at edge of the glass*:

    Shall be limited to 15 mm.

7.6.3 *Dielectric Separation of Dissimilar Metals*

When the framing member for the glazing is aluminium and reinforcement is required to meet the deflection criteria, the reinforcement may be of aluminium or galvanized steel (red oxide coating being not recommended) with an insulating material between them at contact points. It is recommended to choose materials as close to each other in the galvanic series as possible.

7.7 Ultimate Stresses

The ultimate stresses for various types of glass are given in Table 15.

7.8 Insulating Glass Units

7.8.1 *Determining Thickness of Structural Silicone*

The structural bite requirement is directly proportional to the wind load and the dimension of glass. Higher the wind load and larger the dimensions of the glass are, the greater the amount of structural bite required. The controlling variables which affect the structural bite requirement are the maximum short span dimension of glass and the design wind load which the structural glazing system shall be designed to accommodate.

Table 15 Ultimate Limit State Design Stresses for Glass Subjected to Wind Loading

(*Clause* 7.7)

Sl No.	**Glass Type**	**Standard Nominal Thickness, *T*** mm	**Ultimate Limit State Design Stress at Given Location**	
			Away from Edge MPa	At Edge MPa
(1)	(2)	(3)	(4)	(5)
i)	Annealed	3	41.00	32.8
		4	38.99	31.19
		5	37.45	29.96
		6	36.2	28.96
		8	34.33	27.46
		10	32.8	26.24
		12	31.57	25.25
		15	30.15	24.12
		19	28.72	22.98
		25	26.96	21.57
ii)	Toughened	4	97.47	77.97
		5	93.61	74.97
		6	90.49	72.39
		8	85.82	68.65
		10	82.01	65.61
		12	78.91	63.13
		15	75.37	60.3
		19	71.81	57.45
		25	67.41	53.93
iii)	Heat strengthened	3	65.6	52.48
		4	62.38	49.9
		5	59.91	47.93
		6	57.91	46.33
		8	54.92	43.94
		10	52.48	41.99
		12	50.51	40.4
iv)	Annealed laminated	5	37.73	30.18
		6	36.43	29.14
		8	34.41	27.53
		10	32.87	26.3
		12	31.62	25.3
		16	29.75	23.8
		20	28.23	22.58
		24	26.99	21.59

a) *Structural bite calculation for wind load and glass dimension*

$$\text{Minimum structural bite} = \frac{\text{Glass short span dimension x Wind load x 0.5}}{\text{Maximum allowable design stress}}$$

NOTES

1 Glass' short span dimension (SSD) is the shorter of the two dimensions (in m) of the rectangular glass panel.

2 Wind load is the maximum wind pressure, in Pascal, for a return period of 10 years based on local regulations.

3 The maximum allowable design stress for type of the structural sealant is selected as per manufacturer's recommendations.

b) *Determination of thickness of structural silicone* — With a sealed IGU, there may be load sharing between the two lites (panes) of glass. If so and both panes are of the same thickness, the lateral load (P) is shared almost equally; thus the secondary seal bite is calculated as one half that of the structural sealant bite, but should meet the minimum requirement. If of unequal thickness, the load shared by each pane will vary, depending on the difference in thicknesses. Further details are to be obtained from the manufacturer.

c) *Structural bite calculation for dead load*

$$\text{Minimum bite} = \frac{\text{Weight of glass (kg)}}{\text{Perimeter of the glass (m) x Sealant dead load design strength (kg/m}^2\text{)}}$$

$$= \frac{\rho g T A}{P s}$$

where

ρ = 2 500 kg/m^3 is the specific mass of flat glass corresponding to approximately of specific weight.

g = 9.81 m/s^2

s = Allowable design stress for dead load (DL) for selected sealant considered for design, Pa.

T = thickness of the bite, m.

P = perimeter (if the horizontal frame members do not support the glass or deflect under the dead load of the glass, consider 2 times of its height only).

A = area of glass panel, m^2.

7.8.2 *Maximum Allowable Span for Glass and Type*

Maximum allowable span is dependent on the thickness of the glass selected and type of glass used (for example annealed, toughened or heat strengthened glass). The maximum span is calculated in accordance with **5.9** (*see* Fig. 5 for details).

7.9 Safety During Installation

Glass and the coating layer (if any) should not be, exposed to/in direct contact, with aggressive materials such as acid, solvent, cement mortar, etc.

The fixing system of the panel should, in no case, cause shear stresses in the panel, and particularly the bonding interface between the glass sheet and the frame, either under the effect of external forces or due to differential expansion of components.

The protection of glass panel by means of a polyethylene sheet is recommended and shall provide ventilation for the glass in order to prevent thermal breakage.

7.10 Handling and Transportation

7.10.1 *Transportation*

During the transportation of the flat glass (clear, tinted), coated glass (solar control and mirror), lacquered or painted glass the following methods (if other standard packaging specifications are not available) of storage, packing and interleaving shall be followed:

a) Flat glass shall be transported vertically;

b) Glass panes should not come into direct contact with each other by using appropriate interleaving such as powder or foam or paper. The lacquer opacified/ enamel coated/ screen printed glasses shall be separated by paper or foam; and

c) The packing and packing material shall be protected from water and if the glass is wrapped and sealed, the seal should remain closed until the product is used and precautions taken to not damage the packing while handling with a hoisting apparatus.

7.10.2 *Handling*

During the handling of the flat glass (clear, tinted), coated glass (solar control and mirror), lacquered or painted glass, the following guidelines shall be followed:

a) Glass shall be handled with dry, clean gloves, specifically after washing to prevent stain marks on them;

b) Care shall be taken to avoid contact or friction of the coating or the opacified/ enamel/screen printed side with any rough surface or hard objects;

c) A better practice is to handle glass with vacuum cups, and ensure that the vacuum cups and the glass are clean; and

d) It is recommended to keep it clean, if glass sheets are stored again before their processing or installation in the facade.

7.11 Storage at Site

To prevent staining, the storage area at site shall be:

a) A dry, well ventilated location at a sufficiently constant temperature;

b) Protected from rain and running water;

c) Protected from wide changes in temperature or humidity;

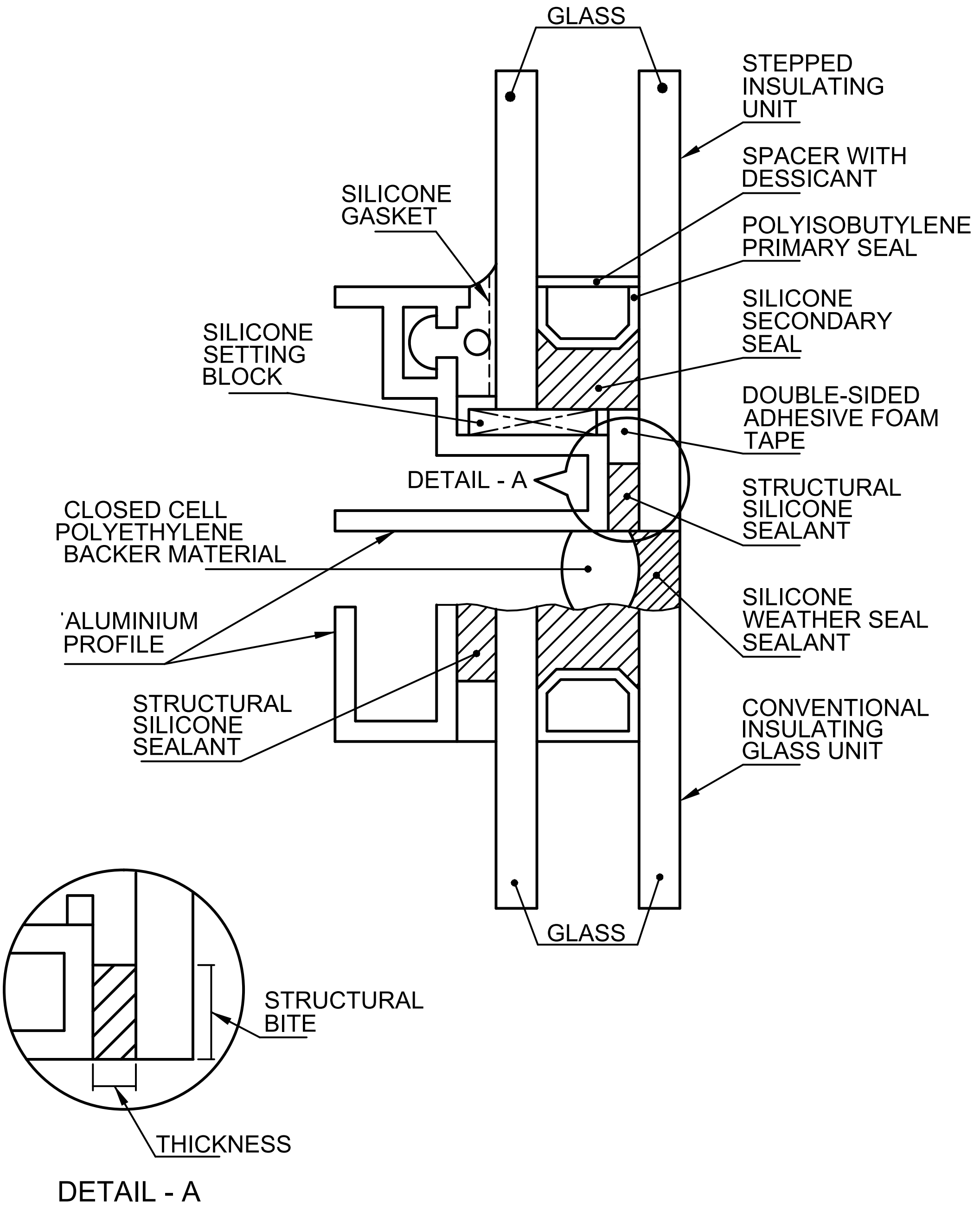

GLASS
STEPPED INSULATING UNIT
SPACER WITH DESSICANT
SILICONE GASKET
POLYISOBUTYLENE PRIMARY SEAL
SILICONE SECONDARY SEAL
SILICONE SETTING BLOCK
DOUBLE-SIDED ADHESIVE FOAM TAPE
DETAIL - A
STRUCTURAL SILICONE SEALANT
CLOSED CELL POLYETHYLENE BACKER MATERIAL
ALUMINIUM PROFILE
SILICONE WEATHER SEAL SEALANT
STRUCTURAL SILICONE SEALANT
CONVENTIONAL INSULATING GLASS UNIT
GLASS
STRUCTURAL BITE
THICKNESS
DETAIL - A

FIG. 5 TYPICAL STRUCTURAL GLAZING DETAIL

d) Protected from alkaline material;
e) Protected from direct contact of aggressive products such as corrosive vapours, acids, etc; and
f) Gass panes are stored vertically on a soft surface such as wooden boards/battens.

7.12 Storage after Cutting

7.12.1 While stacking of coated glass/mirror in the unpacked condition, the glass surface shall be facing towards the front (paint/coating backing towards the back).

7.12.2 Direct stacking of the mirror/coated glass one above the other should be prevented and suitable interleaving material as mentioned in **7.9** should be used between two glass panes.

7.12.3 The support material for glass storage should not have affinity towards moisture absorption.

8 FIRE SAFETY

8.1 This clause covers the requirement and selection of fire safety glass for buildings. General fire safety provisions for buildings can be had from SP 7 (Part 4) : 2016 'National Building Code of India 2016: Part 4 Fire and Life Safety'. It is important for any fire rated glass to provide sufficient amount of human impact safety feature even during fire or in general situations. The level of human impact safety of glass in buildings shall be in accordance with IS 16231 (Part 4). It is necessary that the fire rated system shall withstand the standard time-temperature curve during a fire test and shall give adequate time to the occupants for safe evacuation. This clause does not deal with the safety and security of people or goods in relation to risks of:

a) Vandalism, riots, burglary or break in protection;
b) Protection from explosion (terrorist attack);
c) Natural disasters like earthquakes, cyclone, etc; and
d) Plastic glazing, safety and security glazing, etc.

The requirements given here are minimum fire resistance requirements. In circumstances wherein the requirements of other Indian Standards exceed the requirements of this clause, in such cases the higher requirements shall become applicable.

8.2 Glass for Fire Resistance

8.2.1 Glazing system shall be so constructed, treated, or combined with other materials as to reduce loss of life or property during an event of fire, in comparison with ordinary sheet or flat glass, thereby preventing the passage of flame, hot gases, and smoke. Also, temperature rise on the non-fire side can also be controlled using certain fire resistant glass.

8.2.2 The following are the products in the scope of this clause that may be used for fire resistance in glazing provided they meet the relevant available standards:

a) Wired glass,
b) Annealed fire resistant glass (AFG),
c) Tempered fire resistant glass (TFG),
d) Intumescent laminated fire resistant glass (LFG), and
e) Double glazed fire resistant glass (DFG).

8.2.2.1 *Wired glass* (*Not recommended in doors except as vision panel and for window sizes not greater than in Table 16*)

It is a type of glass into which a wire mesh is embedded during production. Wired glass has an impact resistance similar to that of annealed glass, but in case of breakage, the mesh retains the pieces of glass. Value addition such as tempering and lamination is not possible using wired glass.

8.2.2.2 *Annealed fire-resistant glass*

A single piece of fire resistant glass (borosilicate glass) that is tested for fire resistance for the required duration. These types of glasses can be used only in areas where human impact safety is not an issue, typically in areas like vision panels of doors, oven doors, etc. This type of glass has lower coefficient of expansion and cannot be tempered.

8.2.2.3 *Tempered fire-resistant glass*

A single piece of specially heat-treated that is tested for fire resistance for the required duration and which has a stress pattern such that the piece when fractured reduces to numerous granular fragments, with no large jagged edges. Additionally these glasses should have a impact resistance of highest classification.

8.2.2.4 *Intumescent laminated fire resistant glass*

Two or more pieces of glass held together by an interleaving layer or layers of materials and that as a complete system is tested for fire resistance. Fire side of the glass shall crack and break during the fire or under sufficient impact, but the pieces of glass tend to adhere to the inter-layered material and do not allow the fire to penetrate the last layer of glass.

NOTE — The intumescent inner layer shall also rapidly expand to provide an insulated layer of protection to prevent the spread of fire and smoke and may also prevent thermal heat radiation.

8.2.2.5 *Double glazed fire resistant glass*

Fire resistant glass that is used as a double glazed unit has to be tested as a complete Double Glazed Unit (DGU) or other multiple glazed units as the case may be. Double glazed fire resistant glass can be a combination of intumescent laminated fire rated or

Table 16 Limiting Size of Wired Glass Panel

(*Clause* 8.2.2.1)

Sl No.	Opening Fire Protection Rating in	Maximum Area m^2	Maximum Height m	Maximum Width m
(1)	(2)	(3)	(4)	(5)
i)	60 to 90	0.064 5	0.838	0.254
ii)	45	0.836	1.372	1.372
iii)	20	No limit	No limit	No limit

tempered fire resistant glass. Fire resistant glass cannot be combined with another glass and used as a DGU unless the combined double glazed or multiple glazed units are also tested. Both the panes of the double glazed unit will need to satisfy the required impact safety as mentioned in IS 16231 (Part 4).

NOTE — It should be noted that use of any fire rated glass has to be installed in a tested system. Fire rated glass alone cannot provide the desired fire resistance since the fire resistance of a partition or a door assembly or any glazed building element is a function of the glass, frames, hardware, gaskets and fixings which forms the glazed system.

8.2.3 *Testing Procedures*

Any fire rated glazed building element needs to be tested as per IS/ISO 834-1 and IS/ISO 834-8. The fire rating criteria of any building element shall be in accordance with SP 7 (Part 4) : 2016 'National Building Code of India 2016: Part 4 Fire and Life Safety'.

8.2.4 *Identification of Glass Used for Fire Resistance*

a) All glass used for resisting fire shall conform to and preferably certified against available Indian Standards.
b) Since a fire resistant glass is not easily distinguishable from normal types of glass, it is imperative that every fire rated glass panel/unit should preferably have an indelible mark on all the panels/units of fire resistant glass showing the name of the manufacturer and the name of the product.
c) Rating of the glass panel may also be provided, although the rating of glazing system is of primary concern.

The glass used for fire resistance shall be in accordance with the requirements of SP 7 (Part 4) : 2016 'National Building Code of India 2016: Part 4 Fire and Life Safety'.

8.3 Precautions

8.3.1 Fire resistant glass alone shall not be enough to protect occupants from fire. Glass is only one component of the complete system.

8.3.2 Fire test certificate report conducted for one application shall not be substituted for any other application. For example, a report for a partition shall not be used for a door application although the glass used and the fire ratings are the same. Approval in vertical orientation cannot be considered for acceptance in horizontal or inclined orientation.

8.3.3 The maximum glass size as mentioned in the test report should not be exceeded in practice with respect to the bigger linear dimension or area, unless otherwise validated by an assessment report issued by the testing laboratory. The aspect ratio may be modified provided that none of the linear sides has a dimension greater than that of the largest dimension of originally tested glass.

8.3.4 The dimensions of the profile need to be the same as that tested.

8.3.5 In case of any change in hardware they should be replaced following the guidelines laid down in the standard against which the test was conducted.

8.3.6 Factors like edge cover, types of gaskets and type of fixtures also play a very vital role in achieving the fire performance of the building element. These have to be used and installed as per the test report/available standards.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
875	Code of practice for design loads (other than earthquake) for buildings and structures
(Part 2) : 1987	Imposed loads (*second revision*)
(Part 3) : 2015	Wind loads (*third revision*)
1893 (Part 1) : 2016	Criteria for earthquake resistant design of structures: Part 1 General provisions and buildings (*sixth revision*)
2553 (Part 1) : 1990	Specification for safety glass: Part 1 General purpose (*third revision*)
14900 : 2018	Specification for transparent float glass (*first revision*)
16231	Code of practice for use of glass in buildings:
(Part 1) : 2018	General methodology for selection (*first revision*)
(Part 2) : 2018	Energy and light (*first revision*)
(Part 4) : 2018	Safety related to human impact (*first revision*)
IS/ISO 834-1 : 1999	Fire-resistance tests elements of building construction: Part 1 General requirements
IS/ISO 834-8 : 2002	Fire-resistance tests elements of building construction: Part 8 Specific requirements for non-load bearing vertical separating elements
SP 7 : 2016	National building code of India 2016

ANNEX B

[*Clauses* 5.1(b) *and* 7.3]

METHOD FOR DETERMINING EFFECTIVE THICKNESS OF LAMINATED GLASS FOR ANALYSIS OF STRESSES AND DEFLECTION

B-1 The purpose of the effective thickness method is to provide engineering formula for calculating the effective thickness of laminated glass. Two different effective laminate thickness values are determined for a specific case:

a) An effective thickness, $h_{\text{ef;w}}$, for use in calculations of laminate deflection, and

b) An effective laminate thickness, $h_{1,\text{e},\sigma}$ for use is calculations of laminate glass stress.

These effective thickness values can be used with standard engineering formulae or finite element methods for calculating both deflection and glass stress of laminates subjected to load. The method applies to 2-ply laminates fabricated from both equal and unequal thickness glass plies. The intent of the effective thickness method is to provide a method that allows the user to perform engineering analysis of laminated glass, taking into account the viscoelastic nature of the interlayer.

B-2 The shear transfer coefficient, *T*, which is a measure of the transfer of shear stresses across the interlayer, is given by:

$$T = \frac{1}{1 + 9.6\dfrac{EI_{\text{s}}h_2}{Ga^2h_{\text{s}}^2}} \qquad \dots 1$$

where

$$I_s = (h_1 h_{s;2}^2) + (h_2 h_{s;1}^2) \qquad \dots 2$$

$$h_{\text{s;1}} = \frac{h_{\text{s}} h_1}{h_1 + h_2} \qquad \dots 3$$

$$h_{\text{s;2}} = \frac{h_{\text{s}} h_2}{h_1 + h_2} \qquad \dots 4$$

$$h_{\text{s}} = 0.5(h_1 + h_2) + h_{\text{v}} \qquad \dots 5$$

h_{v} = interlayer thickness,

h_1 = minimum thickness of first glass layer,

h_2 = minimum thickness of second glass layer,

E = Young's modulus of elasticity for glass,

a = smallest in-plane dimension of bending of the laminate plate, and

G = complex shear modulus of the inter layer.

NOTE — For interlayers comprised of a stack of different polymers, the interlayer thickness h_{v}, is considered to be the total stack thickness. The shear transfer coefficient, *T*, varies from 0 to 1.

For calculations of laminate deflection, the laminate effective thickness, $h_{\text{ef;w}}$, is given by:

$$h_{\text{ef;w}} = \sqrt[3]{h_1^3 +} h_2^3 + 12TI_3 \qquad \dots 6$$

For calculations of the maximum glass bending stress, the laminate effective thicknesses (one for each glass layer) is given by:

$$h_{1;ef;\sigma} = \sqrt{\frac{h_{ef;w}^3}{h_1 + 2Th_{\text{s;2}}}} \qquad \dots 7$$

$$h_{2;ef;\sigma} = \sqrt{\frac{h_{ef;w}^3}{h_2 + 2Th_{\text{s;2}}}} \qquad \dots 8$$

B-3 The calculation normally needs only to be performed for the thickest glass, unless there are different types of glass in the laminate that have different allowable stresses. The primary interlayer property that influences the laminate deformation is the complex shear modulus, *G*. The complex shear modulus is a measure of the plastic interlayer's shear resistance. The greater the shear resistance, the more effectively the two glass plies couple and resist deformation under loading. The thickness approaches the equivalent monolithic thickness for stiff interlayers ($T \rightarrow 1$) and approaches the layered limit for compliant interlayers ($T \rightarrow 0$). Key to the use of the method is the accurate determination of the interlayer shear modulus. All interlayers are viscoelastic so consideration must be given to load duration and temperature for the intended use.

Typical load duration-temperature combinations for design purposes are:

a) 3 s/50°C for wind loads, and

b) 60 min/30ºC for live loads.

Contact the interlayer manufacturer for appropriate shear modulus values.

B-4 EXAMPLE

To calculate the maximum glass stress and deflection of a laminated glass beam with dimensions 1.0 m × 1.75 m. The beam is fixed along one long edge (cantilever) and is subjected to a line load, *P*, of 0.75 kN/m applied to the top edge. The proposed laminate construction is 10 mm glass; 1.52 mm interlayer; another 10 mm glass. From consideration of the application, it is specified that the line load duration is 60 min at a sustained temperature of 30ºC. For these loading duration and temperature considerations the interlayer shear modulus, *G*, is determined to be 0.44 MPa.

Therefore,

$h_v = 1.52$ mm

$h_1 = 9.02$ mm

$h_2 = 9.02$ mm

$E = 70$ GPa

$a = 1.0$ m

$G = 0.44$ MPa

Substituting into equations 1 to 8:

$I_s = 501\ \text{mm}^3$

$h_{s;1} = h_{s;2} = 5.27$ mm

$h_s = 10.54$ mm and

T = 0.085.

Effective thickness for deflection:

$h_{ef;w} = 12.56$ mm

Effective thickness for stress:

$h_{1;ef;\sigma} = h_{2;ef;\sigma} = 14.13$ mm .

In order to calculate the maximum beam glass stress, σ_{max}, and the maximum beam deflection, δ_{max}, the effective thickness values are substituted into the standard engineering formulae for a cantilevered beam with a line load:

$$\delta_{max} = \frac{6Pa}{h^2_{1;ef;\sigma}} \qquad \ldots 9$$

= 22.5 MPa

$$\delta_{max} = \frac{4Pa^3}{Eh^3_{ef;w}} \qquad \ldots 10$$

= 21.1 mm

ANNEX C

(*Clause* 5.9)

PROCEDURE FOR CALCULATING THE APPROXIMATE DEFLECTION AT CENTRE OF GLASS PANEL

C-1 Maximum glass deflection as a function of plate geometry and load may be calculated using the following:

$$\text{Deflection, } w = t \,.\, \exp\,(r_0 + r_1 X + r_2 X^2)$$

where

$X = \ln\{\ln[q(a.b)^2/Et^4]\}$

$r_0 = 0.553 - 3.83(a/b) + 1.11(a/b)^2 - 0.096\,9(a/b)^3$

$r_1 = -\ 2.29 + 5.83(a/b) - 2.17\ (a/b)^2 + 0.206\,7(a/b)^3$

$r_2 = 1.485 - 1.908(a/b) + 0.815(a/b)^2 - 0.082\,2(a/b)^3$

where

E = Young's modulus of glass, N/mm^2;

q = net pressure on the pane, N/mm^2;

a = longer dimension, mm;

b = shorter dimension, mm; and

t = thickness of the glass pane calculated, mm.

Example:

Lateral deflection calculation — Determine the maximum lateral deflection (w) of a vertical 1 200 mm × 1 500 mm × 6 mm rectangular glass plate subjected to a uniform lateral load of 1.80 kPa. The actual thickness of the glass is 5.60 mm as determined through direct measurement.

$a = 1\ 500$; $b = 1\ 200$

$r_0 = -2.689$

$r_1 = 2.011$

$r_2 = 0.213$

$q = 1.80$

$E = 71.73 \text{ x } 10^6$

$t = 5.60$

$X = 1.490$

Therefore, maximum deflection at the centre of glass is:

$w = 5.6 \times \exp\,(-2.689 + 2.111 \times 1.490 + 0.213 \times 1.490^2)$

$w = 12.2$ mm

ANNEX D

(*Clause* 5.9)

MODEL CALCULATION OF GLASS THICKNESS

D-1 MODEL CALCULATION

Glass panel dimension of width 1 200 mm and height 1 800 mm for location in Chennai for annealed glass type.

D-1.1 General Checks has to be Done for Safety Performance

a) The maximum area of glass panel is restricted to 15 m^2.

b) The maximum span of window is restricted to 4 m.

c) Applicable to normal, reflective, laminated, tempered and insulating glass.

d) Applicable to rectangular panels properly fixed.

D-1.2 Procedure for Calculating Glass Thickness

a) *Step 1* — Calculate aspect ratio (AR_{max}) from Table 3.

Aspect ratio (AR_{max}) = Longer side/shorter side of glass

Aspect ratio = 1 800/1 200 = 1.5

b) *Step 2* — Wind load calculation

$$P_z = 0.6\ V_z^2$$

$$V_z = V_b.k_1.k_2.k_3.k_4$$

where

V_b = basic wind speed based on location [*see* Fig. 1 of IS 875 (Part 3)];

k_1 = risk co-efficient factor [*see* Table 1 of IS 875 (Part 3)];

k_2 = terrain factor [*see* Table 2 of IS 875 (Part 3)];

k_3 = topography factor [*see* **6.3.3** of IS 875 (Part 3)];

k_4 = importance factor for the cyclonic region;

V_z = design wind speed; and

P_z = design wind pressure, N/m^2, at height, *h*.

Design wind speed for Chennai location

[Basic wind speed = 50 m/s taken from IS 875 (Part 3) = 1 750 N/m^2]

c) *Step 3* — Strength factor

Based on the types of glass (Laminated/Tempered/Insulating Glass) pressure factor is calculated. To determine the thickness of laminated/tempered/insulating glass, the design wind pressure P_{net} is modified as below:

$$P_{net} = P_z/P_f$$

where

P_f = pressure factor dependent on the type of glass.

The values of the pressure factor P_f can be taken from Table 2.

For annealed units, P_f = 1.0, therefore,

P_{net} = 1 750/1.0 = 1 750 N/m^2

At this stage the glass thickness value shall be calculated from the table and then the deflection and stress check be done as described below.

d) *Deflection Check*

The deflection of the glass can be calculated using the formula in Annex C. Actual deflection for the pane shall be obtained as below:

Deflection, $w = t.\ \exp(r_0+r_1X+r_2X^2)$

$X = \ln \{\ln[q(a*b)^2/Et^4]\}$

$r_0 = 0.553 - 3.83(a/b) + 1.11(a/b)^2 - 0.096\ 9(a/b)^3$

$r_1 = -2.29 + 5.83(a/b) - 2.17(a/b)^2 + 0.206\ 7(a/b)^3$

$r_2 = 1.485 - 1.908(a/b) + 0.815(a/b)^2 - 0.082\ 2(a/b)^3$

where

E = Young's modulus (71.7 × 10^6 kPa or N/mm^2),

Q = net pressure on the pane (N/m^2),

A = longer dimension (mm),

B = shorter dimension (mm), and

T = thickness of the glass pane calculated.

The actual deflection is, 4 mm < 11 mm maximum allowable.

Result: 1 800/175 = 10.3 mm, which is the maximum allowable deflection.

Hence the glass thickness calculated is safe against deflection.

Glass thickness calculation:

$P_{net}.A = 200.0\ T^k$ (let $T \leq$ 6 mm)

P_{net} = 1 750

A = 2.16 m^2

K = 1.765

T = 5.28 mm, therefore choose the thickness of glass as 6 mm.

ANNEX E

(*Foreword*)

INSTALLATION OF MIRRORS

E-1 This annex provides general guidelines, which is to be followed during the installation of mirrors. Mirrors (piece of glass silvered on one side, with a protective paint coating) are used in shops, gymnasiums, etc, where it is predominantly used as wall cladding. The mirror panels in such application use large panel size and it is recommended to follow the installation procedure in accordance to this annex.

E-1.1 The mirror should always be mounted on a perfectly flat, clean and dry surface free from acids and aggressive substances such as acid, solvent and cement mortar.

E-1.2 The mirror shall be mounted on wall or plywood and care is taken that the mirror is never stuck over unstable support (painted paper, paint or old plaster). It is recommended that the mirror installation is not done directly on the mirror supports. In order to have good ventilation, following is recommended space depending on the height of the mirror panel:

a) A space of 5 mm for a mirror less than 1 m height; and

b) A space of 10 mm for a mirror greater than 1 m height.

Figure 6 gives typical details of the installation of mirrors. During the installation of mirror panels at several levels that is, one above the other, it recommended to provide a space of 10 mm at the top and at the bottom for circulation of air. The side of the mirror is designed with a minimum 1 or 2 mm

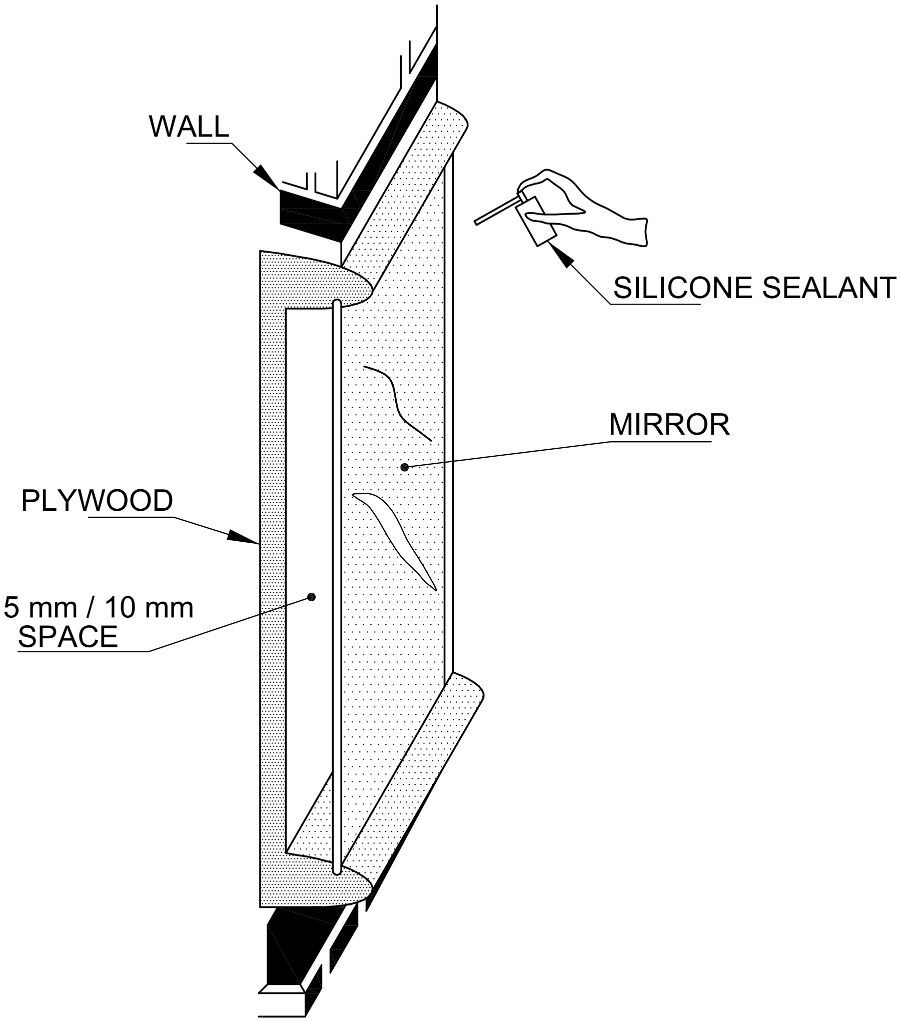


FIG. 6 INSTALLATION OF MIRROR

of interleaving space. When mirror is fixed in a profile (frame), care is to be taken to maintain perfectly dry and clean frame. It is recommended that mirror is supported on hard non-metallic/plastic wedges of at least 3 mm, to raise the mirror and thus avoid contact with the condensed water which could accumulate in the profile. If the mirror is screwed on, the screws of a suitable dimension is designed, with the interleaving and washers (*see* Fig. 7) made of plastic to avoid any direct glass-metal contact. To minimize the risk of breakage, cracks and splinters during screw-mounting the mirror, it is recommended to use synthetic protective collars.

E-1.3 When adhesive is used to mount mirrors, care should be taken to ensure that the adhesive is compatible with the protective coatings on the mirror. It is recommended to use only neutral binding agents such as alkoxy silicone, oxime silicone, etc. Avoid use of acid silicones, such as acetoxy silicones which contain acetic acid or water/rubber/polyurethane-based glues.

E-1.4 In the high humidity areas (for example bathrooms), it is recommended to seal the edges with neutral silicone to protect the backing paint from damage due to moisture and enhanced protection from moisture. It is recommended to use double sided adhesive tapes to fix the mirror on the mounting surface (*see* Fig. 8). The adhesive tapes used for installation must be certified to be compatible with the mirror; and the adhesive or the adhesive tapes must always be fixed vertically.

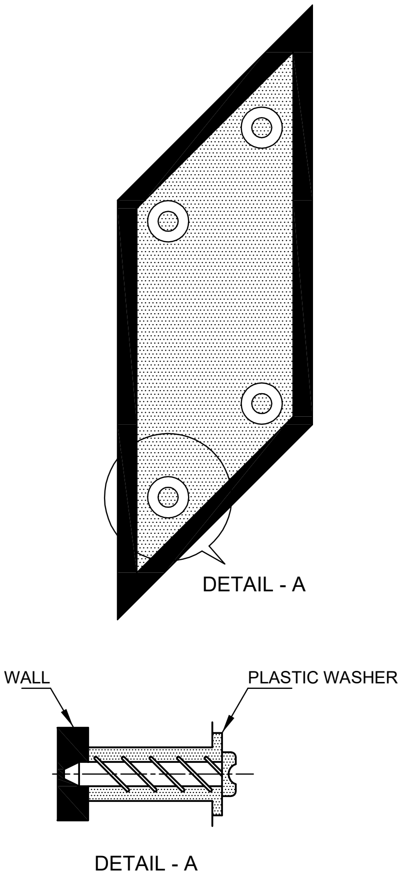


FIG. 7 DETAILS OF USE OF SCREWS AND INTERLEAVING WASHERS FOR INSTALLING MIRROS

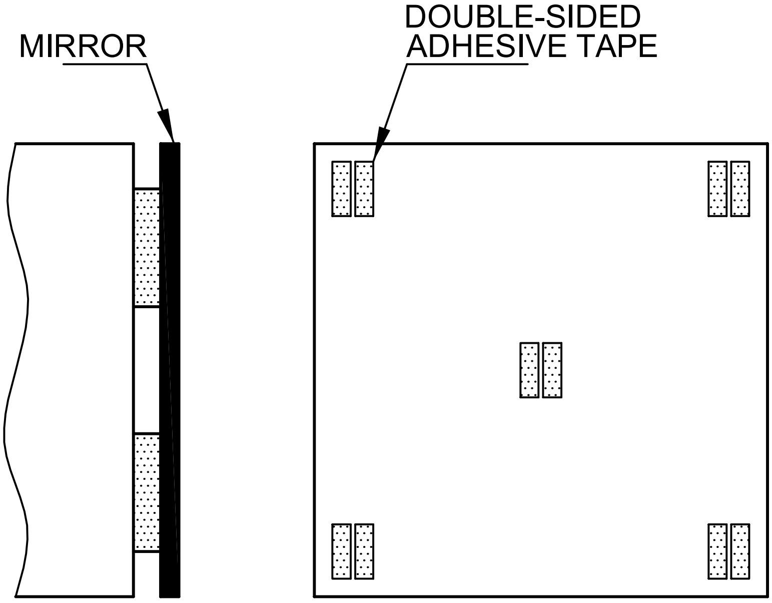


FIG. 8 DETAILS OF DOUBLE SIDED ADHESIVE TAPES FOR INSTALLING MIRRORS

ANNEX F

(*Foreword*)

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